THE

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STEEL FOR PERMANENT MAGNETS.

AMONG recent contributions to our knowledge of iron and steel, the most important is Madame Sklodowska Curie's account of her investigation of the properties of various kinds of steel, with a view to their use for making permanent magnets. This was published last January in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, and in another column we begin an abstract of the paper with some of the more important tabulated results. Mme. Curie has experimented with some 47 different kinds of steel, including a series of ordinary carbon steels having different percentages of carbon, and a number of others containing special constituents—chromium, copper, nickel, manganese, tungsten, and molybdenum. She gives in her paper a complete chemical analysis of all the different steels employed, a table showing the temperatures of magnetic transformation in every case, a table of the usual magnetic properties, viz, the residual magnetisation and the coercivity, tables of the results of experiments on long continued heating, of repeated blows, and of partial demagnetisation, with much other information and comment. A mode of ageing a magnet after manufacture is described, which the authoress found to reduce the subsequent variations of intensity to very small amounts. We take this opportunity of complimenting Mme. Curie on her patient and systematic work. It does not appear that she has made any new departure, or any particular discovery, and her methods are such as most of us are familiar with; but her information is more extensive, varied, and exact, than anything we have previously seen on this subject. It is probable that makers of instruments, in which permanent magnets are used, have discovered rules for treating magnets similar or equivalent to those proposed by Mme. Curie, but they have not made them public property.

The authoress dwells strongly on the identity between the temperature at which steel changes from the magnetic to the non-magnetic state, or *vice versâ*, and that at which steel can be hardened by sudden chill. The fact is now well recognised that the point of recalescence is critical alike for the magnetic and mechanical transformation. She has studied the difference of the transformation point on rising and falling temperatures, but in none of her specimens did this difference approach the amount found by Dr. Hopkinson for certain nickel steels.

In the early part of her paper, Mme. Curie discusses carefully the use and interpretation of the cyclic diagram, and points out the uncertainty of its meaning, if used as a guide to the quality of the material, when obtained from a bar or other open magnetic circuit. None of the results of tests on bars are given in diagrams, the residual intensity and coercivity being merely tabulated, and the figures of the intensities for bars of the same dimensions, which alone are comparable, are put in the same column. In the case of steels tested as rings, the cyclic diagrams are given as well as the numerical

results. Now, although the cyclic diagram of an open circuited magnet is not to be interpreted without reference to the exact form of the magnet, it is still, from one point of view, desirable to have it. In a cyclic diagram the point where the curve cuts the vertical or B axis represents the normal condition of the magnet after manufacture, and the properties of the finished magnet are represented by the character of the curve at that point. The change in the magnetisation due to a small reverse field will be determined by the slope of the curve at that point, and if the curve is nearly horizontal the steel will be magnetically very rigid. The measure of the magnetic rigidity is the intercept on the H axis of the tangent to the curve at its intersection with the B axis and not the intercept on the H axis of the curve itself. This latter intercept, the coercivity, has no necessary connection with the magnetic rigidity in the ordinary magnetised condition, though these cyclic curves are so similar in form that the value of the coercivity is a fair indication of the rigidity, or, in other words, the two intercepts may be nearly proportional to one another for all steels. It is however, quite conceivable that a steel might be found having small coercivity and great rigidity, in which case the upper limb of the cyclic curve would be nearly horizontal on the B axis and drop sharply at a small distance to the left of it. In this case its coercivity would be a misleading indication of the value of the steel.

The percentage difference between the magnetisation in a strong and a zero field might be a more useful criterion than the coercivity, and this quantity is calculated in some Reichsanstalt reports to which we refer later. The most complete information would be given by a small cycle in the immediate neighbourhood of the intersection of the B axis between points given by magnetising fields of, say, + 5 and − 5. The increased stability of partially-demagnetised magnets should be indicated by this small cycle being very nearly horizontal in both limbs. We could wish that Mme. Curie had determined this small cycle for one of her finished and aged bars, and so demonstrated the nature of its extreme rigidity.

As a general result of her investigation, Mme. Curie finds three kinds of steel specially suitable for magnets. She confirms the high character of the well-known Allevard steel, which contains ·59 per cent. carbon and 5·5 per cent. tungsten, but finds that a steel containing 1·7 per cent. carbon and 4 per cent. molybdenum instead of tungsten possesses still higher qualities. This molybdenum steel which came from the firm of Chatillon et Commentry was not then in commercial use. None of the steels examined came from an English foundry, but we have lately seen a Reichsanstalt report on an English tungsten steel, that of Messrs. J. J. Saville & Co., to which we may refer here for comparison. This steel has a coercivity 65, as compared with 74 for Allevard steel, and 85 for molybdenum steel. The residual magnetisations of the different specimens are not comparable, as the forms of the magnetic circuits were different.

Besides these steels, which do not differ greatly from one another, Mme. Curie examined a steel called Boreas, made by Boehler, of Styria, which has a high coercivity, 85. It has properties very different from the others, having a much lower residual intensity, and suggests a possibility of still greater variations in magnetic properties with different chemical constitution. It is evident from Mme. Curie's paper that one of the most important points in the construction of magnets is a careful regulation of the hardening temperature, which should not exceed a certain moderate limit. This is somewhat curious, since the steel in manufacture must have been exposed to much higher and less well regulated temperatures than Mme. Curie found afterwards to be injurious, and suggests that investigations on these steels should be carried out at a stage of manufacture earlier than that at which they reached her hands. It would seem, moreover, from the close connection that exists between the magnetic and mechanical changes that take place at the transformation point that a careful regulation of the hardening temperature should be as important for the mechanical as it is for the magnetic properties of steel. Though manufacturers of springs and cutting tools, as well as metallurgical laboratories, employ refined modes of hardening and tempering steel, the ordinary practice of workshops is extremely rough and ready. One is commonly told that individual tool smiths possess great knowledge of and skill in manipulating their material, but in many shops every workman is expected to be able to make his own tools, particularly such small tools as drills and screw-drivers, and the results are often unsatisfactory and expensive. It would seem that a steel-hardening furnace with a thermo-couple and galvanometer should be part of the equipment of every good mechanical workshop, and that the properties of steel and iron should form as essential a part of the technical training of a mechanic as a course of machine drawing or geometry. Burning a steel cutter that has cost £2 or £3 to machine, or making one waster in every three magnets hardened, would then be unpardonable. Nothing seems more certain than that if the English workman is shown, when young, better methods and more refined conceptions in mechanical practice, the standard of the workshops will rise. The technical education of the older apprentice and the young journeyman, not of the schoolboy, would be the salvation of the English workshops. No one more than the writer respects the English workman's love of good work for its own sake; no one more greatly deplores his ignorance. Every piece of accurate research provides a new text for a discourse on the necessity of technical education for the workman, and no outlay can be more remunerative; only it must be for the workman who knows what work is, not for the overgrown schoolboy. Mechanical engineering is as much the child of the singular properties of steel at its recalescent point, its capacity for being hardened and tempered, as chemistry is of the properties of glass, and no subject is better worth the attention of mechanical engineers and of their employés.

The Boiler Explosion at Barking.

At the moment of writing the only word as to this explosion has been that in the morning papers of Saturday, the day following the explosion. It is stated that quite recently the boiler was tested by hydraulic pressure to 200 lbs. cold and 100 lbs. hot. Apparently its working pressure was 100 lbs., so that the cold test was to double the working pressure, and if this be so we must heartily condemn the practice. There appears some evidence that the explosion took place at the very moderate pressure of 14 lbs. as shown by

the gauge. Now this may or may not be the case. Steam gauges are not always accurate. It is possible that the safety valve was stuck down and inoperative, and that the gauge finger was 14 lbs. on "the second time round." This view may by some be held correct by reason of the terrific wreckage of the place. But even at 14 lbs. pressure a large boiler will be terribly destructive when it explodes. But at the time of writing it does certainly seem possible and probable that the excessive hydraulic test of 200 lbs. was such as to severely strain the boiler, and prepare it for giving way at even 14 lbs. pressure. We have often condemned this coarse test. It is useless and dangerous as generally applied. Properly applied within reasonable limits, and with an expert to note the movements of stayed surfaces at intervals as the pressure rises, the hydraulic test is a useful one. But it is the height of absurd folly to use this test as it often is used, and to the very great excess above working pressure. In New York a police van is driven round with a test pump. Boilers are seized upon and pressed up to a given pressure, being severely strained and weakened by the process, and having failed to burst are given a certificate of safety. This is practically a certificate that the boiler has been strained, and may burst at half its working pressure in consequence. The only use of the hydraulic test is to soothe the minds of ignorant owners and put them in a fool's paradise. We do not say that the Barking catastrophe has been thus caused, but if the stated test has been applied, there is no reason against believing such to have been the case. Later evidence seems to point to there being something wrong with the safety valve, one of the dead men having been actually on the boiler as though attending to the safety valve. Possibly further information will be forthcoming at the inquest or other inquiry.

The Fortunes of a Water-Tube Boile

Trade and Industry reviews the fortunes of the Petersen-Macdonald water-tube boiler in a manner that should be taken into consideration by all intending investors in patents. Patented in 1893, it was not until 1895 that the first boiler was constructed, and, of course, favourably reported on by a number of engineers. Forthwith, with all its advantages, safety and economy, the patents were, in 1896, deliberately sacrificed to a public company for the paltry sum of £170,000, and even this miserable pittance was reduced to £150,000, through some difficulty as to some of the foreign patents. A Newcastle firm undertook to make and exploit the boiler; but before two years had passed, unforeseen defects developed under prolonged pressure, and the makers so far developed and improved the boiler, as to make it necessary to obtain further patents on the improvements, which seemed to constitute a practically new design altogether. Thus while the inventor (and his associates) received £150,000 for an invention which failed, and had to be reinvented, the public might just as well have engaged some competent engineer at, say, £500 a year, to design them a water-tube boiler, have patented it, and gone into the manufacture of the same at an economy of about £149,000, as compared with the course they did actually take. The company now stand possessed of a boiler which is said to have made the voyage to Australia satisfactorily. It is now on its way home, and if still satisfactory, "important developments" are expected. They are, in fact, where they ought to have been when the original patents were sold to them, ready to sell trustworthy boilers. Our contemporary suggests that company promoters should observe more caution in taking up new and insufficiently tested inventions, and we quite agree with this. We do not say it has been the case in this particular instance, but we do say that in many instances promoters care nothing for the value of an invention or its mechanical fitness. They promote anything which they can get certain engineers to put their names to. We have very little faith in any water-tube boiler patents, for any reasonably experienced engineer with backing of capital could design a water-tube boiler as good as most which are successfully in use, and if there are any investors anxious to invest in water-tube boilers, we could put them in the way of doing so at very much less than £150,000, and they could have their own works, with best modern machinery, and not require to have their boiler made for them on royalty. But they must not pay our expert £150,000. He will be satisfied with a tenth this amount.

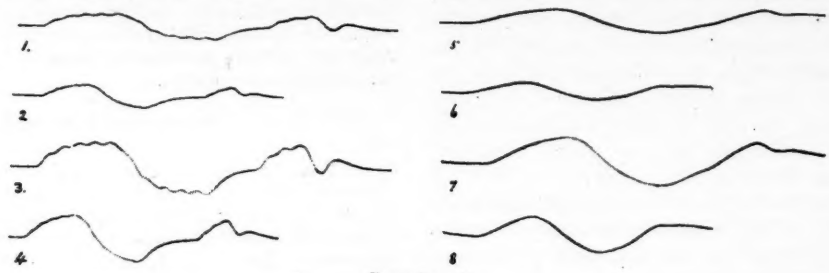
A New Phase Indicator.—*L'Electricien*, in the issue of November 26th, gives an account of a phasemeter designed by Dr. Th. Bruger, of the firm of Hartmann & Braun, which is intended to indicate directly on a scale the phase difference between an alternating circuit and the E.M.F. of the supply mains. The principle of the action of the instrument is as follows:—A rectangular coil carrying an alternating current placed in an alternating magnetic field is pivoted about an axis in its own plane and perpendicular to the field. This coil experiences a torque about the axis proportional to the cosine of the angle between its plane and the field, and also to the cosine of the difference between its phase and that of the field. Two such coils, similar to one another, are fixed together on the same axis, with their planes at right angles, the combination being free to revolve without any mechanical control. They carry equal alternating currents, differing in phase by a right angle. One of these currents is derived directly from the alternating supply mains, and the other, in quadrature with it, is obtained by a device which we shall describe presently. If the angle between one coil and the field is α, and the difference of its phase from that of the field be ϕ, the torque acting on the coil may be represented by an expression, $A \cos \alpha \cos \phi$. The torque on the other coil, fixed on the same axis at right angles to the first will be $A \cos\left(\frac{\pi}{2} - \alpha\right) \cos\left(\phi + \frac{\pi}{2}\right)$, *i.e.*, $-A \sin \alpha \sin \phi$, acting in the opposite direction. It is not difficult to see that the whole system will turn about its axis to a position in which the two torques balance, *i.e.*, when $\alpha = \phi + \frac{\pi}{2}$. A pointer attached to the moving system will then indicate on a scale divided from a suitable zero the value of ϕ both in magnitude and direction; *i.e.*, the difference in phase between the field and the E.M.F. impressed on the moving coils. The field is produced by coils carrying the main current, the difference of whose phase from that of the E.M.F. of the supply mains is required. To obtain a current in quadrature with its E.M.F., the primary of a small induction coil is placed in series with a non-inductive resistance across the supply mains, and the secondary of the transformer in parallel with the same resistance, the terminals of the secondary being connected to those of the resistance. It may be seen that the constants at our disposal in this arrangement can be calculated to give a displacement of the phase of the current in the resistance by a right angle from that of the mains. When this is nearly done, a final adjustment can be readily made by altering the resistance of the secondary circuit of the transformer with a rheostat. The mode of obtaining a current in quadrature with the E.M.F. used by M. Bruger is somewhat more complicated than this, and employs two transformers, but it is essentially similar. This solution of the problem of constructing a direct reading phase indicator is certainly ingenious, but it depends wholly on an assumption that all the actions are sinusoidal. Even if this were true of the E.M.F. of the supply mains, it will be generally true neither of the supply current taken from them, which is being examined, nor of the small current in quadrature obtained by means of two transformers. Nor can we assign any exact meaning to the expression "phase difference" in the case of two alternating currents, one or both of which has several sinusoidal components. In practice, the cosine of the phase difference is replaced by the power factor. If these criticisms be met, and it is quite possible they may, by a practical success in giving the power factor, the instrument should be very useful.

SIPHON RECORDER SIGNALS.

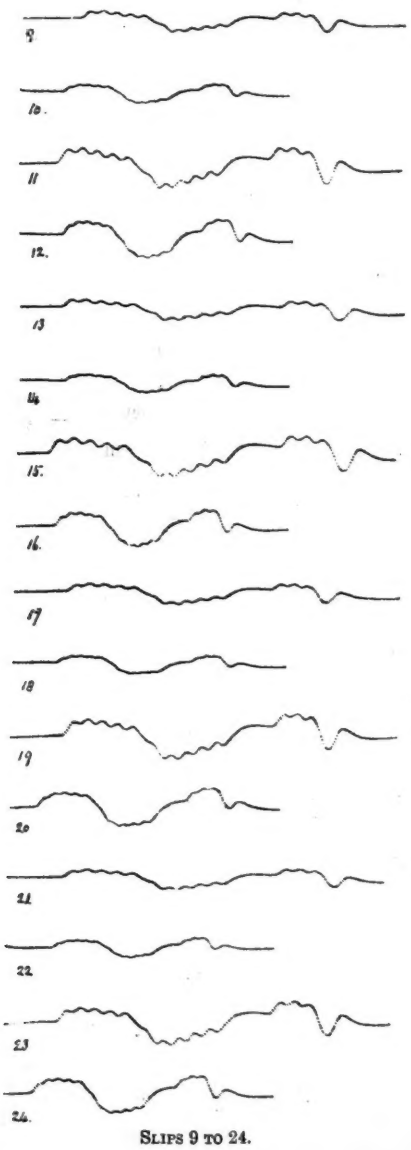
By J. RYMER-JONES.

The writer has taken advantage of the opportunity which a long artificial cable affords, to make a series of experiments showing the characteristic features of Recorder signals under varying conditions as to the capacity of the signalling condensers at the sending and receiving ends, speed of transmission, and battery power; and to ascertain the effect on signals of different shunts for the Recorder coil, of high resistance shunts on the signalling condensers, of condensers having low insulation resistance, and also of one or more "leaks" on the cable.

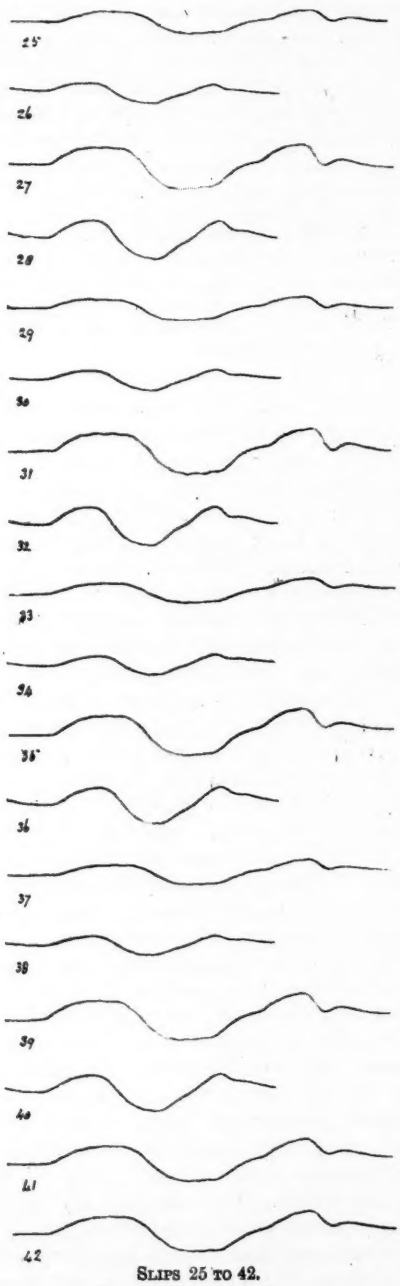
As little has hitherto been published on the subject, the information which the illustrated experiments convey may be of value to some who have not had a very extended experience of the Recorder when working under widely different conditions, or facilities for making experiments for themselves on cables differing considerably in length; and by affording a clearer insight into a rather complex subject may serve as a guide to the best conditions for working.



Slips 1 to 8.



Slips 9 to 24.



Slips 25 to 42.

The signal "understand" and figures 5 and 0 have been selected for comparison under all conditions of working, and to economise space the number and length of illustrations are limited to these three signals. When referring to them, the expression *rise* or *fall* is intended to signify respectively that a succession of similar elements become more and more removed from, or approach nearer and nearer to, the zero line.

The following abbreviations are employed:—

C refers to the longer cable having a C R = 5,296$^{\omega}$, and capacity = 677 mfds.

c refers to the shorter cable having a C R = 2,648$^{\omega}$, and capacity = 339 mfds.

S C = sending condenser; R C = receiving condenser; w.p.m. = words per minute; S = shunt.

An automatic transmitter has been employed, the lower speed at which the perforated tape travels being regulated to 16 w.p.m., and the higher speed to 25 w.p.m.

The speed of the Recorder slip has been kept as uniform as possible for *both speeds* of signalling to avoid any modification in the shape of signals, which the slip travelling at different rates would introduce. The same shunt resistance on the Recorder coil has been used when practicable for experiments at the same speed, with both the higher and lower battery power, so that signals may be as comparable as possible. The siphon recorder employed is one of the permanent magnet recorders with the siphon attached direct to the coil and vibrated by a Dickenson's vibrator, a more sensitive instrument not being at the time available.

No Signalling Condensers at Either End of the Cable

		16 w.p.m.				25 w.p.m.		
Cable.	Series.	Slip.	Cells.	Recr. s.	Series.	Slip.	Cells.	Recr. s.
c	*a*	1	15	9	*b*	2	...	9
		3	30	,,		4	...	,,
C	*c*	5	15	20	*d*	6	...	20
		7	30	,,		8	...	,,

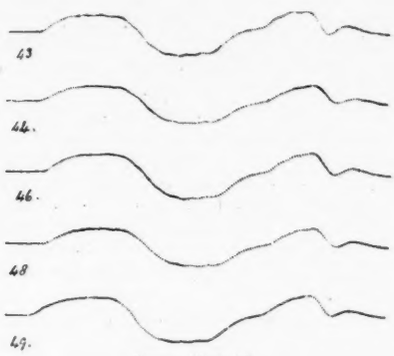
These signals *rise* from the zero line and with the exception of slip 3, for the shorter cable C, have little or no definition between consecutive elements. In the case of the longer cable, C, there is practically no definition at all owing to the great retardation of signals which are received in the form of smooth waves. Increasing the battery, or reducing the speed, only increases the size of signals without appreciably altering their specific character.

A very important advantage of a condenser at the sending or receiving end is, of course, that only *sudden* changes in the *earth current* affect signals. Without a condenser the siphon is sometimes deflected permanently off the slip by earth currents, and has to be brought back by torsion or some other retracting force.

Condensers also produce a marked *curbing* effect, *i.e.*, signals are much more defined than when no condenser is used. When placed at both ends of the cable the curbing effect is much greater still. It makes no difference whether the condenser be at the sending or receiving end, or whether the cable be long or short.

Speaking generally—with a condenser at only one end, signals do not show the unsatisfactory *rise* observed in the case of a long cable when no condensers are used; nor on the other hand is the *fall* so marked as when condensers are at both ends of a cable of only moderate length.

More battery is required with than without a condenser to produce a given amplitude of signal, but less than when a condenser is used at both ends.



Slips 43 to 49.

With a condenser at only one end of the longer cable C, doubling the battery cells gives larger signals and better definition than increasing S C [or R C] from 50 to 100 mfds. (slips 43, 44). Also, when S C [or R C] is increased from 50 to 100 mfds., and the shunt adjusted to give the same size of signal, the 50 mfds. give better definition than 100 mfds. (43, 46). Slips 43, 48 show, moreover, that with the same shunt, 50 mfds. and 30 cells give larger and better defined signals than 100 mfds. and 15 cells, or even 18 cells

Signalling Condensers at only one End.

		16 w.p.m.					25 w.p.m.				
Cable.	Series.	Slip.	Cells.	Recr. s.	S C.	R C.	Series.	Slip.	Cells.	Recr. s.	S C.	R C.
c	*e*	9	15	50$^{\omega}$	30	0	*f*	10	15	50$^{\omega}$	30	0
		11	30	,,	,,	,,		12	30	,,	,,	,,
,,	*g*	13	15	,,	0	30	*h*	14	15	,,	0	30
		15	30	,,	,,	,,		16	30	,,	,,	,,
,,	*i*	17	15	30$^{\omega}$	60	0	*j*	18	15	30$^{\omega}$	60	0
		19	30	,,	,,	,,		20	30	,,	,,	,,
,,	*k*	21	15	,,	0	60	*l*	22	15	,,	0	60
		23	30	,,	,,	,,		24	30	,,	,,	,,
C	*m*	25	15	250$^{\omega}$	30	0	*n*	26	15	250$^{\omega}$	30	0
		27	30	,,	,,	,,		28	30	,,	,,	,,
,,	*o*	29	15	,,	0	30	*p*	30	15	,,	0	30
		31	30	,,	,,	,,		32	30	,,	,,	,,
,,	*q*	33	15	110	60	0	*r*	34	15	110	60	0
		35	30	,,	,,	,,		36	30	,,	,,	,,
,,	*s*	37	15	,,	0	60	*t*	38	15	,,	0	60
		39	30	,,	,,	,,		40	30	,,	,,	,,
,,	...	41	30	60$^{\omega}$	100	0						
		42	30	,,	0	100						

(slip 49). In order, therefore, to improve definition, it appears better to increase the shunt or battery [provided, of course, that the D R of the cable permits], rather than the condenser capacity beyond (say) 50 mfds.

16 w.p.m.

Cable.	Slip.	Cells.	Rec'rs.	S C	R C
c	43	30	200	50	0
"	41	15	"	100	0
"	43	30	200	50	0
"	46	"	100	100	0
"	43	30	200	50	0
"	48	15	"	100	0
"	49	18	"	"	0

With the shorter cable *c*, there is a *fall* towards the zero line at both 16 and 25 w.p.m. for the last four elements of 5 and 0, which is more noticeable with the larger deflections. The character of the first two consecutive signals is altered when the speed is increased from 16 to 25 w.p.m., there being a slight *rise* in the case of the smaller signals at the higher speed, whereas in the larger signals at the lower speed this is not nearly so apparent.

There is a marked *rise* noticeable at 25 w.p.m. for figures 5 and 0 received through the longer cable. At 16 w.p.m., however, only the first two elements rise, while the succeeding ones are in nearly a straight line, showing only a slight tendency to rise. It will be seen, therefore, that for these signals increasing speed tends to increase their wavy character and the increased *rise* to reduce definition. Reducing the battery gives smaller signals, but their character remains much the same.

(To be continued.)

RECENT LEGISLATION IN RELATION TO THE SUPPLY OF ELECTRICITY FOR LIGHT AND POWER.

By FRANK BALFOUR BROWNE, of the Middle Temple, Barrister-at-Law.

(*Concluded from page* 4.)

One or two of the developments in relation to legislation during the last session of Parliament are worth looking at in this connection. One of the most interesting was the proposal of the General Power Distributing Company to incorporate itself under Act of Parliament, to erect a generating station at Worksop, and to obtain powers to supply electricity in a large district defined by a circle with a 26 mile radius from the generating station at Worksop. Within this area of supply there were certain great towns which had already obtained authority from Parliament to supply electricity within their own municipal boundaries, and these towns opposed the Bill on the ground that if it were passed into law it would enable a company to enter into competition with the local authorities—would enable a company possibly by "cutting rates" to force the corporation to conclusions and so secure the purchase of the company's undertaking. A good deal of the argument for and against the Bill turned upon the obscure language of Section 1 of the Electric Lighting Act, 1888. That section is to the effect that "notwithstanding anything in the Electric Lighting Act, 1882, no provisional order authorising the supply of electricity by any undertakers within the district of any local authority shall be granted by the Board of Trade except with the consent of such local authority unless the Board of Trade, in any case in which the consent of such local authority is refused, are of opinion that having regard to all the circumstances of the case such consent ought to be dispensed with, and in such case they shall make a special report, stating the grounds upon which they have dispensed with such consent. The grant of authority to any undertakers to supply electricity within any area, whether granted by license or by means of provisional order, shall not in any way hinder or restrict the granting of a license or provisional order to the local authority, or to any other company or person within the same area."

The earlier part of this section was relied on by the opponents of the Bill. They said in effect that the local authorities were meant to be masters of the situation. They could withhold their consent, and in that event it was only under special circumstances on a special report, that their refusal could be got over. The later words of the section were relied on by the promoters. Nothing, they said, was to prevent another license or provisional order being granted when one had already been granted; that was meant to encourage competition. We are prepared to compete. If Sheffield and Nottingham can supply more cheaply than we can, then we will do no harm to them; if we can supply more cheaply than they can, from having a more constant load, so much the better for the consumers.

It was upon grounds like these, although we have given them in the most meagre epitome, that the case was fought out, and in the result the Committee of the House of Lords, presided over by Lord Northbrooke, to whom the Bill was first referred, declared that it might proceed.

It is evident, even from this abbreviated statement, that the Bill raises some of the most important questions which could be raised in connection with municipal government, and the provision of such matters as light and power by private enterprise. We refrain from touching upon these matters, as we understand that the Bill has, in the ensuing session (1899), still to be fought out before a committee of the House of Commons. It is obvious, however, that if the Bill passes, it will introduce the possibility of competition in relation to the supply of electricity.

Now competition has been tried in relation to gas, and in relation to water supply, and, after trial and failure, has been abandoned. But there is another curious feature to be noted in connection with this Bill. In the past, competitive companies have always come to an understanding and combined. Competition between statutory companies and local authorities in relation to water (Public Health Act, 1875, Section 52) is forbidden while the water company is doing its duty, and a similar protection is given to statutory gas companies under Section 161. It is true the Act does not recognise the rights of non-statutory companies to protection against the competition of local authorities either in relation to gas or water, but no local authority could raise the capital necessary to enable it to compete with an existing, although non-statutory company, without the consent of the Local Government Board, and that Board, rightly, we think, has always refused its sanction, unless the existing company's undertaking was purchased by the local authority asking leave to become the purveyor of gas and water. Now this Bill is, as counsel called it, a new departure. It proposes to allow competition between local authorities and companies, and that whether the local authorities are in default or not. This seems a step backward instead of forward, but, as the matter is, in a sense, *sub judice*, we do not propose to say more about it in this place.

There was a very similar question raised in relation to a provisional order in the last session of Parliament, although the question was raised from quite another point of view. The Metropolitan Electric Supply Company had, with the consent of the Vestry of Marylebone, obtained a provisional order empowering them to supply that district with electricity. At the time the order had been applied for, there had been an important inquiry by Major Marindin (for the Board of Trade) as to what should be the extent and nature of the area to be granted, and, further, as to whether concurrent powers should or should not be granted to two or more companies within the same area. This inquiry, which was an exhaustive one, was held soon after the passing of the Electric Lighting Act, 1888. In his report, Major Marindin allotted certain areas to certain companies, and in one part said: "The only districts applied for in which I have decided not to recommend the granting of orders as amended are the parishes of St. Pancras and Paddington, where the local authorities should, I think, be granted time to decide definitely whether or not to carry out the lighting of these parishes under the powers of a provisional order; and the City, which, although not exempted from the operation of

the Electric Lighting Acts, is in a somewhat different position from other parts of the metropolis."

Under these circumstances, the Metropolitan Electric Supply Company said with some force: "In Paddington Major Marindin refused to grant us an order at that date, because the Vestry there had not made up their minds whether they would supply or not. In Marylebone, on the other hand, we got our order because the Vestry of that parish had made up their minds not to supply. We are in the parish with the consent, in a sense, by the invitation of the local authority."

Before going on with the narration of what took place in Parliament last year, it is worth while to make one other quotation from Major Marindin's report. Under the head of "competition," he says:—"(5) That in the abstract, competition is desirable as tending to keep down the price and to cause the manufacture and supply of electricity to be carried on with all the attention and energy which it is possible to devote to it. The competition with gas, which at present, at any rate, and probably for many years to come, will appeal to a totally different class of customers, will not be nearly so effective, while the potential competition from the power of calling in a new company in an area badly served is not likely to be called into play until the bad service has passed through many degrees and has reached a very low ebb indeed. The question how many companies should be granted concurrent powers in one area requires more consideration. In cases where the local authority objects to the entrance of any company, and it is decided to override the objection, I think that one company only should be granted powers. In cases where two or more companies have obtained the assent of the local authority, the following facts must not be lost sight of:—1st. That the laying of the mains of several companies up one street means so much dead capital, and, moreover, the provision of a certain amount of useless material which the local authority would have to pay for, if it should decide to purchase the undertakings after the lapse of 42 years. 2nd. That, no matter what regulations or stipulations may be made as to laying of mains, the interference with the streets and the consequent inconvenience to the public must be in a certain degree proportionate to the number of companies having power over these streets."

"For these reasons," the report goes on, "I am of opinion that, for the present, powers should not be given to more than two companies over the same area, and inasmuch as the companies supplying under the alternating current and transformer system cannot supply electric energy capable of use for motors, that both these companies should not be those using this system."

No one can doubt that this was a most important report after a very full inquiry, but it has been variously interpreted, by one set of persons as a report in favour of competition, and by another set of persons as against competition. The criticisms have probably been dictated rather by the argument which was sought to be advanced than by sober rules of construction. To us it seems that the deliverance faces both ways. Major Marindin begins by pointing out that, in the abstract, competition is desirable as tending to produce moderate prices and efficient management. But he forgot that as to the securing of moderate prices, the public are not dependent on the rather crude method of competition, but that there is to be a septennial revision of the charges of companies in the interests of the public. After that general statement, however, all his arguments are against competition, and when he comes to his recommendation that two companies should be allowed to supply in one area, he is not recommending competition, for he says that they should be companies supplying what are practically different commodities—that is, electricity in the one case for light and in the other for power. We can understand such a recommendation, but we could not understand anyone who has looked into the history of competition in other directions in the past recommending competition as a means of regulating electric lighting companies. The Legislature has always been willing to leave the regulation of monopoly enterprises to competition; it saved the Legislature the trouble of regulating them by statute. Competition means that two or more companies will regulate one another in the interests of the public. But, as was pointed out, where combination is possible, competition cannot last. Companies may foolishly begin to cut each other's throats or rates, which may for a time be an advantage to the public; but the companies would soon be wound up if they went on doing it. Competition was relied on in the case of railways, and for a time the companies competed actively; but in the end they always combined, and then recouped themselves out of the pockets of the public. There is one notable instance of combination of old rivals before Parliament this year, and the amalgamation of the South-Eastern and London, Chatham and Dover Railway Companies will be advocated as a measure which is in the interests of the trading and travelling public. But Parliament has despaired of competition making railways "philanthropists," and has passed many Acts for their regulation. Competition has not succeeded any better in the case of gas undertakings. It was encouraged by Parliament, but it failed to effect its purpose. The companies in London and Edinburgh and elsewhere, without the leave of Parliament, divided the competitive areas into non-competitive districts, and in the end Parliament had to sanction this "illegality," when it became convinced that the "districting" was really in the interests of the public.*

Now we return to the Marylebone Electric Lighting Provisional Order, 1898. The order proposed to allow the Vestry to supply electricity in the parish in which, as we have seen, the Metropolitan Electric Supply Company had, with the consent and encouragement of the Vestry, been supplying since the year 1889.

In the same session the Bermondsey Vestry also obtained a provisional order from the Board of Trade, although the London Electric Supply Company were, in fact, supplying electricity within the parish. These provisional orders raised the question of whether there was or was not to be competition in the supply of electricity; and so important was the principle felt to be, that the expediency of allowing the orders to be referred to a Select Committee was discussed in the House of Commons, and the motion for the second reading was only carried by 198 votes to 114.† Under these circumstances, the Bill for confirming the orders came before a committee presided over by Sir A. F. Godson on July 12th last (1898), and the whole matter was very fully discussed. Of course, the promoters relied upon Section 2 of the Act of 1888, to which we have already referred; the opponents relied upon the general arguments against competition; to the fact that the Metropolitan Electric Supply Company was in the parish with the consent of, and under agreement with, the Vestry, who now sought to compete and ruin them; that they had done their duty well by the public; and that it would be a monstrous thing to allow competition between the rating authority and a company. It was argued, too, that although the Public Health Act, by Sections 52 and 161 allowed the local authority to establish water works and gas works in the district of a non-statutory company in words quite as strong as those relied on in Section 1 of the Electric Lighting Act, 1888, yet the Local Government Board had never sanctioned a loan in the hands of a local authority to carry on such competition, but always insisted upon the company's undertaking being purchased before the local authority was allowed to supply. Indeed, the argument was carried further, and it was said that the Board of Trade, in allowing these orders to come before a Committee of Parliament, although they expressed no opinion on the merits, were guilty of a new departure, and two important cases were referred to to show that their practice was not to encourage competition, but to make local authorities purchase the existing works before they empowered them to supply electricity. We can only quote these cases from the speech of counsel. "This, sir," he said, "is the first time, so far as I ever heard, of competition with a local authority being allowed. Let me tell you what the Board of Trade has done—this same Board of Trade that sends this order to you. In 1896 there was a company supplying Bath under a seven years' license. I dare say you know that under the license system the company got no rights whatever; it only got leave to supply electricity for a certain number of years—for seven years—and this company's seven years were almost out—

* The same is true with regard to the London water companies. In 1852 competition in various districts seems to have been relied on. As a fact, although the areas of supply of various companies overlap, there is no effective competition between the water companies to-day.

† "Hansard," June 14th, 1898, pp. 183—207.

nearly done—the license gone. The local authority applied for a provisional order, and so did the company. The Board of Trade inserted in the provisional order of the Bath Corporation a clause making them purchase the works of the company that was moribund or almost dead. That was Bath, 1896. But a more extraordinary thing is this: Here is Leamington, in this very year. The company had no power at all; it was supplying merely by its own sweet will, and I suppose it had got leave from somebody to lay down or hang up its wires. Competitive orders were applied for by Leamington and by the company. The Board of Trade refused the corporation order without a purchase clause, and ultimately, because a purchase clause could not be agreed upon, it rejected the Leamington corporation order altogether." * In the end, the result was that the Committee decided thus:—"In the Marylebone case we find the provisional order should not be confirmed. In the Bermondsey case we suggest that the order should be withdrawn, as the point raised is not, in our opinion, as presented to us, ripe for discussion. We are of opinion that that local authority should consider the question in the light of purchase. We think that if by original order or by purchase, any local authority becomes the sole power for electric lighting in its district, it should not be interfered with by competition through the granting of a provisional order to any company in such district." †

With regard to the Bermondsey order, further discussion took place on a subsequent occasion. The Vestry brought up what they called a suspensory clause, preventing them from supplying electricity until they had purchased the mains of the company. That proposal was opposed by the company, who said it was turning an order from a competing order into an order for compulsory purchase of their mains, and in the end the Committee's decision was to the following effect:—"We had hoped that some friendly arrangement might have been made which would have been advantageous to both parties. That not being the case, we have only one duty to do, and that to give our decision upon the question of the confirmation of the order, and the order is confirmed." ‡

It is a little difficult from these proceedings to predict what will be the legislation in the future in relation to the important question of competition in the supply of electricity. The Committee rejected the order which would have allowed competition in Marylebone, and expressed a view against permitting competition by a company with a local authority; but the same committee, after trying to bring about an arrangement between the company and the local authority, and failing, passes the order permitting competition in Bermondsey. The reason of the rejection of the one, and the confirmation of the other, seems to have been that in the one case the company attacked was proved to have been doing its duty, and that in the other case, the company had failed in that regard. If that was the ground of the decision it is intelligible, but even when a company has failed in its duty it is a question whether the first suggestion of the committee was not the wisest and best, namely, that the local authority should "consider the question in the light of purchase." We cannot but think that a defaulting company should not be allowed to monopolise a district to the prejudice of the public, but at the same time the local authority seeking to apply and expropriate a company ought to do so only on the condition that it pays the company full compensation. In the Bermondsey case the company resisted that proposal and fared worse than it would otherwise have done.

It is more than probable that similar questions may arise in the coming session of Parliament, and we have thought that the collection of these notes on the matter might be of some use to those who have to deal with this most important question in relation to private Bill legislation.

Wireless Telegraphy.—The *Dover Standard* states that the Wireless Telegraph Company are making experiments between the South Foreland Lighthouse and the East Goodwin lightship, a distance of 10 miles.

* See *Proceedings*, July 14th, 1893.
† See *Proceedings*, July 15th, 1898.
‡ *Proceedings* of July 21st, 1898.

THE MAGNETIC PROPERTIES OF TEMPERED STEELS.

MME. SKLODOWSKA CURIE published last January in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, a long account of her numerous systematic experiments on the magnetic properties of tempered steels, of which the following article is a highly condensed translation. Some of the tables of Mme. Curie's results are, however, translated *in extenso*, condensation in these cases being neither possible nor desirable. She examined a large number of steels of different compositions and from different foundries, and the account of her results is prefaced by a careful statement of the usual accepted nomenclature and notation, and of the experimental methods employed.

Objects of the Experiments.—The specimens were examined in the form of rings and of bars, and in each case the principal magnetic quantities determined were the intensity of the residual magnetisation after extinguishing a saturating field, and the coercive force, *i.e.*, the reverse field required to extinguish all magnetisation, these two quantities being the most important in the construction of permanent magnets. The chemical composition and the recalescent point or transformation temperature of each steel were also ascertained.

In the case of a closed ring uniformly magnetised, the experimental results are referred to a diagram (fig. 1) of the

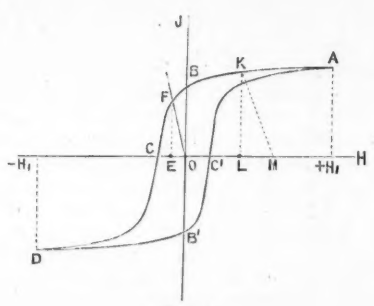


FIG. 1.

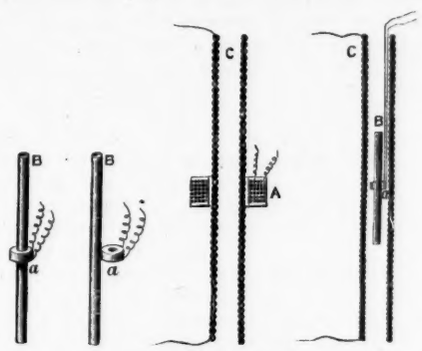
usual form, where + H_1 A, − H_1 D represent the maximum values of the magnetisation attained, O B the value of the residual magnetisation, denoted throughout the paper by I', and O C is the coercive force or coercivity, the reverse field required to completely demagnetise the ring. This quantity is always denoted by H_c. In the case of an uniform closed ring uniformly magnetised all round, the lines of magnetic flux are closed in the metal itself, and no part is subject to a demagnetising force due to free poles. The diagram applies equally to all parts of the ring.

In the case of a bar, the magnetising force will not be identical throughout, and the demagnetising action of the free poles will be neither uniformly distributed nor negligible. Such a diagram as fig. 1 can only refer properly to one point of the bar, or at least to one section. In Mme. Curie's paper the symbols refer always to the median section of the bar. Moreover, at each stage of the magnetising cycle the free poles at the ends of the bar produce a demagnetising field proportional to the intensity of the bar's magnetisation, which may be taken to be similarly distributed for all degrees of intensity, and proportional to the intensity of the central section.

Thus the external magnetising force required to produce a magnetisation, L K, is O M, in the case of a bar instead of O L in the case of a ring, the excess, L M, being required to balance the demagnetising field of the free poles. The excess, L M, is proportional to K L, and the line K M makes the same angle with the axis at whatever point of the limb, A B C, K is situated. So when the external magnetising force is extinguished the residual magnetisation is represented by E F, where O F is parallel to M K, and O E is the demagnetising field of the free poles. The value of the coercive force, O C, is not affected, and this corresponds with the experimental results obtained in which the coercive force for any specimen of steel was found to be the same for a bar and a ring, while the residual magnetisation of the ring, represented by O B,

was always greater than that of the bar, represented by E F, and the difference decreases as the length of the bar is increased, until with long bars no difference is observed.

Method of Procedure with Straight Bars.—In dealing with straight bars three quantities were determined: (*a*) the magnetic moment of the bar giving the mean intensity of magnetisation; (*b*) the flow of induction across the central section; (*c*) the coercive field. (*a*) was determined by comparing the action of the bar on a magnetometer with that of a solenoid of determined dimensions carrying a known current; (*b*) was measured by suddenly withdrawing a small exploring coil placed round the middle of the bar, and connected in series with a ballistic galvanometer. The galvanometer was calibrated at the same time by the throw from another coil withdrawn from a solenoid of known size carrying a known current. In practice this rather cumbrous method was only used to determine the constants of certain bars used for reference, which were afterwards conveniently used for comparison with those on which the experiments were being made. (*c*) was measured by means of a small exploring coil shown in fig. 5, which could be rapidly slipped on and off the bar while in the magnetising solenoid. In calculating the intensity of magnetisation from the flux



FIGS. 2, 3, 4 AND 5.

through the central section, the flux due to the field of the free poles has to be considered, and for this purpose the flux due to the free poles through the coil *a* is considered to be same in the positions of figs. 2 and 3. If B be the flux per unit of area through the coil *a* in fig. 2, measured on the ballistic galvanometer by slipping it off quickly and carrying it away, and B′ the flux in the opposite direction through the coil in fig. 3, we have for the intensity of magnetisation of the bar $4\pi I = B + B'$. Fig. 4 is a view of the solenoid and exploring coil used to calibrate the ballistic galvanometer.

Method of Procedure with Rings.—When examining the materials in the form of closed rings, these were made in two halves which could be separated, and allowed an exploring coil to be slipped out. Figs. 6, 7, 8, show this arrangement clearly. The half rings, *a d*, *a′ d′*, the abutting surfaces of which are carefully surfaced and polished, are packed with sand into semi-circular magnetising solenoids, of which the turns are shown in section by the same circles. An exploring coil, *b b′*, is arranged so that it can be readily slipped out when the two halves of the ring are separated. The advantages and disadvantages of this arrangement are clear. The convenience of having a closed circuit to magnetise, is combined with the convenience of an open circuit for examination by an exploring coil. On the other hand, free polarity near the joints introduces some error into calculations made on the assumption that the magnetic circuit is closed. Each new observation after breaking the circuit must be made in the course of a fresh magnetising cycle, and the residual magnetisation, especially in the case of soft steels, is reduced by the reverse field of the free poles. In deducing the magnetisation, I, of the ring from an observation of the flux, ϕ, through the coil, *b b′*, the flux, ϕ', due to the magnetising solenoid, must be determined by a separate experiment and subtracted. Then we have

$$4\pi I s = \phi - \phi',$$

where *s* is the sectional area of the steel.

Mode of Heating the Bars.—At first the steel bars were heated by a gas furnace in a mixed bath of the fused chlorides of potash and soda, but afterwards by an electrical furnace similar to that used by M. Charpy. The bar was placed in a porcelain tube heated by a spiral of platinum wire carrying a current, and to save the loss of heat by radiation the tube was packed with calcined magnesia into a much larger earthenware vessel. The heating process was particularly interesting. The bar was magnetised by the heating current, and a small compass needle at the side of the furnace opposite one of the poles was deflected by the magnetisation of the bar to a direction perpendicular to the earth's field. The magnetising solenoid had nearly no action

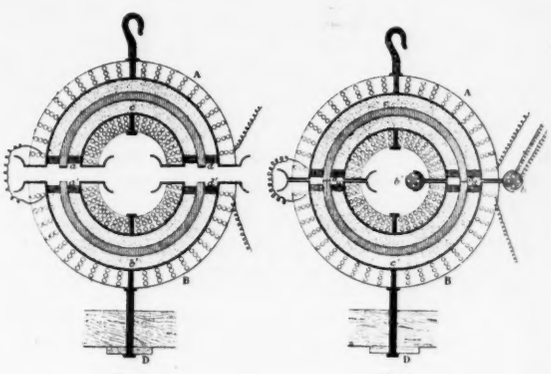


Fig. 6. Fig. 7.

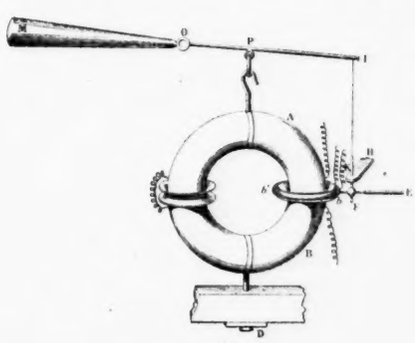


Fig. 8.

on the compass. At high temperatures steel is not magnetic, and the compass needle points in the magnetic meridian. While the magnetic transformation is taking place, one can observe the needle changing its direction, and determine the temperature at which this occurs. *This Temperature is exactly that which must be exceeded in Heating the Steel for the Purpose of Hardening it.*

Afterwards a bath of the mixed chlorides heated electrically by a spiral of nickel wire carrying a current was used for rings and for some bars. The temperature of a bath heated in this way can be very conveniently regulated. Nickel was found to be well adapted for electric furnaces, and saves the excessive cost of platinum. The temperatures were determined by means of a Le Chatelier couple and a galvanometer. The boiling point of sulphur, 445°, and the melting point of gold, 1,050°, were employed to graduate the scale, the galvanometer deflection between these two points being assumed to be a linear function of the temperature. The melting point of sodium chloride was thus found to be 772°, and the transformation point of iron 745°. Mme. Curie describes the mode of ascertaining the exact deflection corresponding to the melting point of gold.

Different kinds of Steel Examined.—Among the steels examined were a series having different percentages of carbon, and very little of any other element than carbon and iron. These steels came from the foundries of Firminy, Unieux, and Boehler, of Styria. There were besides a number of special steels, containing different amounts of carbon, and in addition boron, copper, silicon, manganese, nickel, tungsten, and molybdenum from the foundries of Châtillon et Commentry and Fourchambault; steels containing chromium and tungsten from the foundry of

Assailly; and tungsten steel from the Allevard foundry, and from that of Boehler in Styria. Complete analyses of all the steels studied are given in a table.

Temperatures of Transformation.—The method of following the magnetisation of a bar by the heating current, by observing its action on a magnetometer needle, has been already described. When the bar is being gradually heated the magnetisation at a certain temperature falls rapidly to a very low value. This is called the temperature of magnetic transformation. Now on slowly cooling the bar, at a certain temperature, an inverse change takes place, and this temperature is generally lower than that of the former change. Two temperatures have then to be considered, those of magnetic transformation on cooling and on heating. The change from a high to a low permeability is not absolutely sudden, but is spread over several degrees, and on arresting the change of temperature at any stage the magnetisation remains steady at the value it has then reached. Mme. Curie, for the purpose of stating her results, takes the temperature of transformation to be that at which the iron has a certain permeability intermediate between its high and low value, determined, of course, by the magnetometer. The experiments were not precise enough to give any very exact information on the variation of these temperatures with the composition of the steel, but general conclusions are drawn: 1. That the temperature of transformation by heating falls with the percentage of carbon; 2. That the difference between the transformation temperatures is very small for low carbon steels, increases up to a maximum of 40° to 50° for a proportion of about ·8 per cent. carbon, and then diminishes.*

The temperatures at which steel can be hardened by sudden cooling are those of magnetic transformation, and there is the same difference between the hardening temperatures on an ascending and descending grade. When the steel is heated up to or above a temperature at which it becomes non-magnetic, it can be hardened by plunging into water, and on cooling it remains capable of being hardened as long as it remains non-magnetic, that is, to the lower temperature of transformation. An interesting example is given of the magnetic properties of a steel bar heated and magnetised at different temperatures near the transformation points. The bar was 20 cm. long by 1 cm. square, and contained ·84 per cent. carbon. H is the coercive force, and I the intensity of the residual magnetisation.

Temperature of magnetic transformation on heating, T_1 . 730°
" " " cooling, T_2 . 680°

	H.	I.
Steel annealed	8	85
" quenched at 705°, *i.e.*, above T_2, but below T_1	14	130
" quenched at 770°, *i.e.*, above T_1 ...	52	410
" quenched at 695° during slow cooling after previously being heated to 800°	50	380

Effect of Cutting Screw Threads.—The effect on their magnetic properties of hardening steel wires by cutting threads on them in a screw plate was found to be insignificant, though the tensional strength was greatly increased thereby.

(*To be continued.*)

THE ELECTRO-CHEMICAL AND ELECTRO-METALLURGICAL INDUSTRIES IN 1898.

By JOHN B. C. KERSHAW, F.I.C.

THE year which has just closed has not brought forth any strikingly new process in the domain of industrial electro-chemistry or electro-metallurgy.

One important process has been virtually abandoned—the Ashcroft zinc recovery process; one important patent case has been decided—the Castner-Kellner Rhodin litigation; and a process which is not yet, but which may become important—the Swinburne sulphide ore process, has been brought before the investing public.

But if there has been a decided lull as regards the experimental or industrial development of new processes, there has been steady advance all along the line in 1898 in connection with those already operating upon a commercial scale; and the progress made by these during the past year has been satisfactory, and in some cases phenomenal. In order to obtain a general idea of this advance, the more important manufactures or industries will be dealt with *seriatim* in alphabetical order.

I.—ALKALIES AND BLEACH.

One new electrolytic alkali process has been brought to the writer's notice in the year 1898. The Salt Union are experimenting at Winsford with this new process, the invention of Mr. James Greenwood, but no details are yet available for publication. The Rhodin cell, the *début* of which was celebrated with so much *éclat* at the Hotel Cecil, in October, 1897, has been declared an infringement of the Kellner patents, and has retired again into private life. With regard to the three English processes, the Castner-Kellner is developing most rapidly, and the works as originally designed for 4,000 H.P. is now nearly completed. The Richardson and Holland process at St. Helens is not such a success as the promoters hoped, and it is rumoured that the fresh capital now being raised is to be expended upon Le Blanc plant. The Hargreaves-Bird process is still working satisfactorily upon a small scale at Farnworth. The company which is being promoted to work this process upon a large scale in Cheshire has not yet been floated. Judging from the advance prospectus, of which the writer has seen a copy, and from knowledge of the experimental trials at Farnworth, the Hargreaves-Bird Electrolytic Alkali Company should prove a financial success. The Hulin process, of which a full description will be found in the article named below,* is now in operation at Clavaux, Savoy. At St. Gobain, near Paris, the Hargreaves-Bird process is in operation. Most of the remaining works abroad use either the process of the Elektron Company, first operated at Greisheim, near Frankfort, or that of the Bitterfeld Elektrochemische Werke; but neither of these companies are willing to give any details of their methods. A large number of subsidiary companies are being promoted by these two firms, between whom some form of amalgamation has been arranged; and during the year 1898, the writer has taken note of *six* new electrolytic alkali companies, and twelve new electrolytic alkali works, chiefly developments of the operations of the Greisheim and Bitterfeld companies. Certain of these new works are already working; the remainder will probably be completed during the present year.

No correct estimate of the total output of the Electrolytic Alkali Works is yet possible. The Castner-Kellner Works at Weston Point are now producing about 2,500 tons caustic alkali, and 5,500 tons bleach per year, and will double this output when the works is completed. The Elektrochemische Werke of Bitterfeld, inform the writer that at their two works they now produce 14,000 tons bleach per annum. Borchers in 1897, estimated that the German Electrolytic Alkali Works were decomposing between 15,000 and 20,000 tons potassium chloride per annum; and this total will probably be exceeded during the present year. It is very significant of the progress that has been made in electrolytic bleach manufacture in Germany, that whereas that country formerly imported practically the whole of her requirements, she now covers these by her home production, and in 1897 *exported* over 13,000 tons.

The following list of places where electrolytic alkali works are in operation is believed to be correct:—

Runcorn, St. Helens, Farnworth, Greisheim, Bitterfeld (2), Rheinfelden, Westeregeln, Ludwigshafen, St. Gobain, Hallein, Saltville, Niagara, and Rumford Falls; total, 14.

Works are being constructed and will be in operation in 1899 at the following localities:—

Osternienberg, Geneva, Zombkowie, Clavaux, Montiers, Giffre, Livet, also one each at unnamed places on the Ebro in Spain, in Poland, in France, and in America; total, 11.

II.—ALUMINIUM.

The manufacture and utilisation of this metal is slowly but steadily growing. The total output of all the manufac-

* It will be remembered that Hopkinson found this difference to be many hundreds of degrees for certain nickel steels.

* The *Electrician*, March 4th, 1898.

tories in 1897 was estimated to be 3,400 tons; while the 1898 output will probably exceed that of 1897 by a few hundred tons. The only works in this country, that at Foyers, produced 300 tons in 1897, as against 1,814 tons produced by the Pittsburg Company at the two Niagara works. A new process, "the Péniakoff process," has reached the industrial stage of its development during the past year, and is now being operated at Selzaete in Belgium. The difference between this process and the Hall and Herault processes consists in the substitution of aluminium sulphide for the oxide in the electrolytic baths; the sulphide being obtained by reduction of aluminium sulphate. The writer does not consider the process a very promising one; but until figures of the cost and efficiency have been published, no accurate judgment upon it is possible. The Brussels Company who own the patents are about to exploit the process at Givors in France.

As regards utilisation, the only new outlet for aluminium opened during the past year, has been as a reducing agent in the production of ferro-chromium alloys at Essen and elsewhere. For this purpose the aluminium is used in the form of powder, and owing to its great affinity for oxygen, refractory oxides of chromium and the rarer metals can, by its aid, be easily reduced. The metal is also of service for producing high temperatures. A brief notice of this use of aluminium has already appeared in our columns (see ELECTRICAL REVIEW, August 19th, 1898).

The rise in the price of copper is increasing the attention which is being given to aluminium as an electrical conductor; and in America two power transmission schemes at Niagara and one in Washington county have been equipped with aluminium transmission lines. Articles and letters bearing upon the relative costs of copper and aluminium when used for conducting purposes, will be found in the issues of the ELECTRICAL REVIEW for September 2nd, 9th, 16th, and December 16th, 1898

The following are the places where the manufacture of aluminium is at present carried on:—New Kensington, Niagara (2), Foyers, La Praz, Selzaete, Neuhausen, and Rheinfelden. These eight works have power equal in the aggregate to 20,000 H.P., available for the manufacture, and can together produce about 25,000 lbs. aluminium per day of 24 hours.

During 1898, one aluminium works, that at St. Michel, has ceased to produce. The works at La Praz are being extended, and the erection of new aluminium works is being planned at Givors, in France, and at Sarpsborg, in Norway.

III.—CALCIUM CARBIDE AND ACETYLENE.

If activity on the part of inventors and company promoters be any criterion of success, the manufacture of calcium carbide is at present the most successful of the electro-metallurgical industries.

The writer considers, however, that this activity is not justified, either by the present or the prospective demand for carbide; and unless it is moderated, there will be a similar collapse to that which was witnessed in the period 1882—84, during the early years of the electric lighting industry. That acetylene gas will prove under certain conditions, and in certain situations, a useful lighting agent, he does not doubt. It has, however, to meet as rivals, coal gas, oil, and electricity; and since the two first of these are, when burnt under the best conditions, cheaper illuminants, and the latter is much more convenient, acetylene gas can have but a limited field of usefulness. At present its adoption even in this limited field is hindered by the tendency of acetylene burners to smoke, and by the frequency with which fatal explosions are produced on the part of ignorant users of the gas. These hindrances are doubtless only temporary in character; but at present they exist and cannot be left out of account. The aggregate output of calcium carbide by all the works engaged in its production is not easily ascertained. According to the *Mineral Industry* return for 1897 the production in that year in America amounted to 2,287 tons, and at Foyers, Scotland, to 360 tons. The number of works producing carbide has been greatly augmented during 1898, and the writer believes that the following lists of works in operation and works in course of erection in December, 1898, are essentially correct.

Carbide works in operation: Niagara (2), Sault Sainte Marie, Appleton, St. Catherines, Foyers, Birmingham, Ingleton, La Bathie, Bellegarde, St. Béron, N.D. de Briancon, Froges, Sechilienne, Chapereillon, Lancy, Crampagna, Frankfort, Bitterfeld, Rheinfelden, Augsburg, Neuhausen, Valorbes, Vernier. Vernayaz, Lauterbach, San Martino, Papigno, Ivrea, Ebro, Trolhatten, Brussels; total, 32.

Carbide works in course of erection: St. Marcel, Brega, Serres, Gampel, Birmingham, Meran, Sarpsborg, Quebec, Hinton, Ijace, Holcombe Rook, Thusis, Klosters, St. Etienne, Epierre, Giffre, and three others in Austria; total, 19.

Where the market is to be found for the carbide produced in 1899 by these 51 works, is a question which some of their promoters, we fear, do not stop to ask; but it will become a very pressing consideration if dividends are to be paid on all the capital invested in this industry.

During the year 1898, the Bullier patents have been declared void in Germany, and litigation over the Wilson patents has entered upon its preliminary stage in this country. The decision will probably be given during the present year, and the carbide industry in the United Kingdom will then be on firmer ground than that occupied at the present time.

(*To be continued.*)

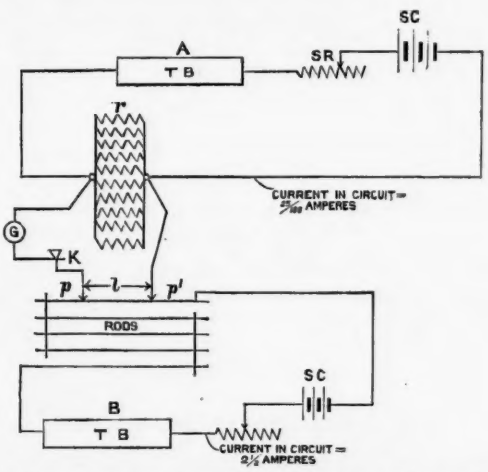
THE CONDUCTIVITY OF ALUMINIUM.*

BY EDWIN F. NORTHRUP.

THE following tests of the conductivity of some aluminium rods manufactured by the Pittsburg Reduction Company were recently made with considerable care. Some of the specimens tested were marked by the manufacturers as pure aluminium and others as alloyed with certain percentages of copper.

A potentiometer method slightly different from that usually employed was adopted, partly on account of its accuracy and partly because the instruments employed had been previously carefully standardised by the writer.

Fig. 1 is a diagram of the connections.



S B, Slide resistance; S C, Storage cells; *r*, Ten 1/10 ohm coils in parallel = 1/100 ohm; A B, Thomson balances.

The method consisted essentially in balancing two equal potentials against each other. In one circuit was a Thompson balance (previously calibrated by a voltmeter test), storage cells, a variable slide resistance to adjust the current to one-fourth ampere, and 10 one-tenth ohm coils of a Queen-Anthony bridge connected in parallel. This bridge had been previously compared with a Nalder 10-ohm standard. Knowing the current by the balance to an accuracy of one-fifth of 1 per cent., and the resistance *r* to an accuracy of one-tenth of 1 per cent. or less, the potential drop over *r* was known to within an accuracy of certainly one-fifth of 1 per cent.

* New York *Electrical World*.

The aluminium rods were connected in series in another circuit with another Thompson balance which would read $2\frac{1}{2}$ amperes to within an accuracy of one-fifth of 1 per cent.

A delicate D'Arsonval galvanometer and a key, K, were placed between these circuits as indicated, and $p\,p'$, the contact points, were mounted on a steel rod so that the distance between them could be varied and accurately measured. The distance between these points was then changed until on touching them to the aluminium rod no deflection was observed on the galvanometer, G. The method was sufficiently sensitive to indicate different resistances at different portions of the same rod due to the varying thickness of the rod itself. The test was made in a room of nearly constant temperature, and the current through the rods caused a scarcely appreciably rise in their temperature. This temperature was 26·9° C.

Proper corrections were made for the known error and temperature of the resistances r. The diameters of the rods were measured in several places by micrometer calipers. The conductivities were all reduced to the conductivity between the opposite faces of a centimetre cube and compared with the conductivity of a similar cube of pure copper at 27° C. The value taken for this was one divided by 0·000001767. In actual practice the percentage conductivities of the different specimens of aluminium were calculated by the formula:

$$K = \frac{\cdot 000001767\ l}{0\cdot 785\ 4\ D^2\ R}, \text{ where}$$

K = percentage conductivity of aluminium compared with copper at the same temperature as that of the aluminium, l = distance in centimetres between contact points on aluminium rod, D^2 = square of diameter of aluminium rod, and R = resistance of aluminium rod between contact points.

R, of course, $= \frac{e}{c}$, where c is the current ($2\frac{1}{2}$ amperes) measured by one balance, and e is the known drop over the resistance r.

The following table exhibits the character of the specimens tested and the results obtained:

Character of specimen.	Length of rod, l, necessary to balance.	Cross section in square centimetres.	K = per cent. conductivity.
Pure al.	46·10	0 13184	61·59
Pure al.	29 00	0 08302	61 50
0 75 % copper	67·75	0 1165	56 37
Pure al.	73·46	0·2:05	61 45
* 0·5 % copper	71 43	0 2704	58 16

* Two-tenths of an ampere in circuit through known resistance for this specimen, 25-100 ampere for the other specimens.

It is interesting to note that alloying copper, a better conductor for an equal cross section than aluminium, reduces the conductivity of pure aluminium.

The writer believes that these results can be relied upon by users of aluminium to within one-half of 1 per cent., and probably a little closer.

THE ELECTRICAL ENGINEER.

Commenting on Mr. Preece's statement that all engineers of the future will be electrical engineers, it is hoped by *Engineering* that they will no longer be so called, but that the generic term for engineer will cover everyone, whether he be the so-called civil, mechanical, or electrical engineer. But we cannot altogether agree that the engineer of the future must necessarily be an adept in electrical science. Indeed, we think that the engineer of to-day, who is not an electrical expert, is apt to be far more inconvenienced by lack of that knowledge than will his future brother. The early engineers of the Fairbairn or Rennie type were men of all-round attainments, and in their days an engineer was expected to be capable of anything; but to-day this is not so, and in the future it will be less so. True, all engineers in the future will be more or less familiar with electrical machinery, just as to-day we are all fairly equipped in knowledge of steam engines, boilers, shafting and pulleys, or think we are, the reason being that we have been brought up with these things in daily view, and if we don't know very much about them, we have such knowledge of them, and of their constructors, that we know how to set about buying them. It will be the same with electrical machinery in a few years. Everyone will know where to buy what he requires. We are at one with our contemporary in the view that sound mechanical knowledge is at the bottom of all successful engineering, be this electrical or otherwise. A mere knowledge of the laws of electricity does not make a man an educated engineer, and electricity alone is comparatively useless. The man who would promote and carry out some large scheme of power transmission would find himself confronted with obstacles other than electrical.

If a water-power is to be utilised he must know something of the rainfall of the district, of its watershed area, its geology; he must know something of pipes and conduits; possibly of tunnels. Turbines must come within his grasp, and only after this point does his electrical knowledge come into play. Now, few engineers can be experts in everything they have to handle, and there is no more necessity for an engineer to be an adept electrician than there is for him to be an expert hydraulic engineer or tunneller. A world-wide knowledge is a fine possession, but life is too short to acquire it.

As in the past so in the future; the engineers of the largest and most successful undertakings will depend, whether they care to do so or not, upon the men whom we will call, for want of a better term, the chief draughtsmen of the manufacturing contractors. We hear much of the position of draughtsmen, and of their abilities and want of ability, but the manner of man we have before us is the one we all know who is the brain of the manufacturing establishment. Usually he is an example of the fact that a so-called technical education is not an absolute necessity; he is not an expert mathematician, but he is gifted with a capacity for work and a sound mechanical judgment, and it is to such men as he that the credit is largely due for the excellence of machinery turned out by contract firms. Few consulting engineers could draw a specification for any works in great detail in a way to obtain results equal to those which can be obtained from the standard goods turned out by reputable firms. One of the duties of the engineer in his consulting capacity is to know who are the capable firms rather than to himself design plant. We venture to say that some of the most successful engineers of to-day who have carried out electrical work are by no means experts in electricity, but they are good engineers, and know how to work up general plans, and where to stay their hand. Nor are the best engineers ever afraid of admitting where they are lacking. They recognise the infinitely wider experience in separate fields of individual contractors, and make it their duty to utilise the knowledge and experience of perhaps half a dozen experts to produce a good and harmonious result.

The successful engineer in the future will be very much the same man as he is to-day, and engineers as a mass will, then as now, tend to those branches in which they are most interested, best informed, or, where there is no choice, which an apparent chance puts in their way as a means of livelihood, for in very many instances the employment followed by an engineer is that which necessity, rather than choice, forces upon him, and if be an engineer, he will rapidly become an expert in whatever branch he may find his energies directed.

THE HELLESEN DRY BATTERY.

The following tests made at the Reichsanstalt on the Hellesen dry cell, as made by Siemens & Halske, will show how much these dry cells have been improved in recent times.

The results of the tests are represented graphically in the annexed figures. The battery cells are square in form, and are made in seven different types, type 1 and type 2 being the two largest sizes. The internal resistance of type 1 is about 0·08 ohm, and of type 2 about 0·10 ohm, and these

resistances increase very slowly with use. The weights of the elements 1 and 2 are respectively 2·9 and 1·75 kilogrammes.

Fig. 1 shows the falling off of the E.M.F. of type 1 (two tests), when discharged with a constant current of 0·2 ampere. The initial voltage of 1·58 falls to 0·36 when discharged under the above conditions for 19 days.

Fig. 2 shows the drop in the voltage of type 2 (two tests) when discharged with a constant current of 0·1 ampere for

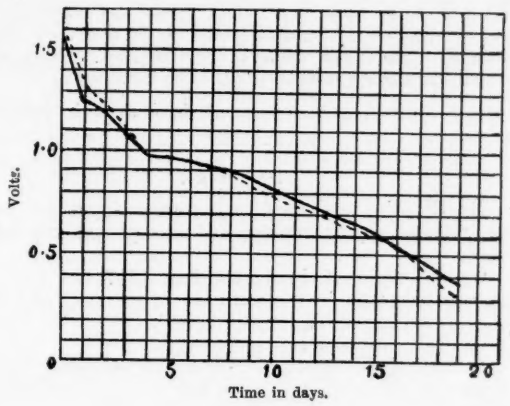


FIG. 1.

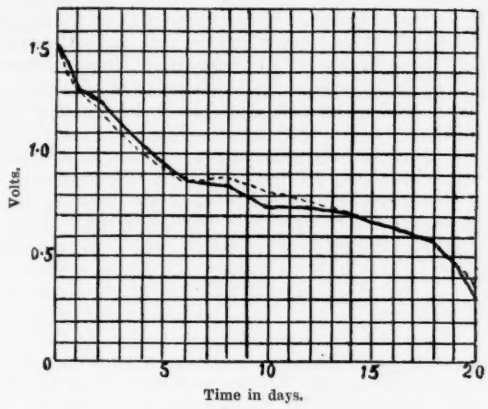


FIG. 2.

20 days. The initial voltage, 1·52, falls in 20 days to 0·32.

Fig. 3 shows the drop in voltage of type 1 when discharged through constant resistances. Curves I *d* and I *e* represent the voltage when the discharge takes place through an external resistance of 5 ohms, and curves I *f* and I *g* when discharged through resistances of 10 and 20 ohms respectively.

Fig. 4 shows the drop in voltage of type 2 when discharged through constant resistances. Curves II *d* and II *e* represent the voltage when the discharge takes place through an external resistance of 10 ohms, and curves II *f* and II *g* when discharge takes place through external resistances of 20 and 50 ohms respectively.

Type 1, discharged through a resistance of 10 ohms, supplied a total quantity of 145·3 ampere-hours, and when discharged through 20 ohms, gave 88·4 ampere-hours during

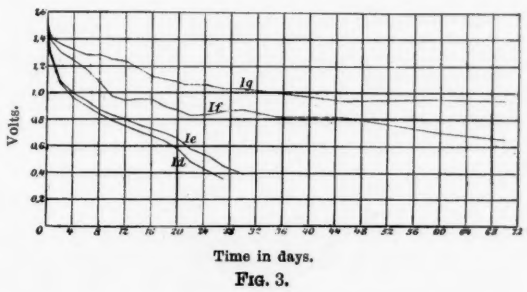


FIG. 3.

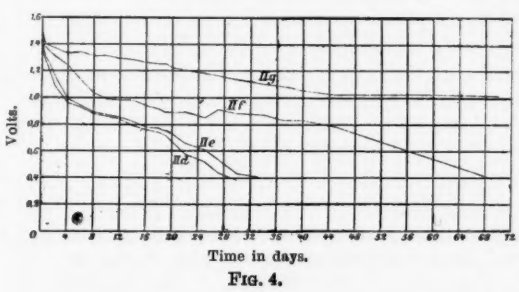


FIG. 4.

the experiments. The external work done during the experiment by the element with an external resistance of 10 ohms was 129·6 watt-hours. The fact that this amount of work, if expended in raising the cell, would raise it to a height of 16,394 metres, will give some idea of the large amount of energy per pound of the battery.

In consequence of their large output and other advantages, these elements are extensively used for telegraph and telephone work, for electro-medical work, electric bells and laboratory work.

Use of Single-Phase Motors.—The *Electrical World* says that in the city of Frankfort-o.-M, in Germany, single-phase motors, with an aggregate capacity of 1,400 horse-power, are run from the town lighting mains.

REVIEWS.

Michael Faraday: His Life and Work. By SILVANUS P. THOMPSON, D.Sc., F.R.S. London: Cassell & Co., Limited.

Biographies of Faraday have more than once appeared, and the appreciation in which they have been held is evidenced by the fact that they are out of print; hence the production of the present volume, which may help to keep the memory of the colossal master-mind green. The addition of hitherto unpublished matter on the subject of the book is one justification for its publication.

The author has executed his task (if it may be called such) in a manner which calls for warm commendation. We find not only a general review of Faraday's scientific researches, but also glimpses into his private life, which are very interesting. Were it not that the life of Faraday has been more than once written, the publication of Prof. Thompson's book would call for more notice than it actually requires. It is a work which may be read with interest and profit by a very large number of readers. A very significant statement, which deserves to be borne in mind by those who are fond of clothing their discoveries in mathematical formulæ, which, however comprehensible to the discoverers, are often wholly incomprehensible to others:—"Would it not be a good thing if mathematicians were to give us their results in this popular useful working state as well as in that which is their own and proper to them?"

The Automotor and Horseless Vehicle Pocket-Book, 1899. London: F. King & Co., 62, St. Martin's Lane, W.C.

This excellent little pocket-book has been considerably improved since its first edition. It appears to embody information on roads, tractive power, motors, petroleum products and fuel generally, tables of gradients, the customary tables of properties of materials, monetary equivalents, and everything one can think of as likely to come within the range of the automobile engineer, though the electrical section is somewhat short, about 10 pages chiefly occupied by figures relative to accumulators.

E

Centrifugal Pumps, Turbines and Water Motors. By CHAS. H. INNES, M.A. Manchester: The Technical Publishing Company. 1898. 3s. 6d.

Many books have been published on turbines, and as a rule turbine makers have freely exposed their methods, but as the author of this book remarks, there is a good deal of reticence among makers of centrifugal pumps, and no one seems to know very much about these machines. Indeed, we believe that centrifugal pumps have been developed by a long series of practical tests, and evolved by trial and error. Certainly they have become very efficient machines on low elevations. The present writer once had a Gwynne centrifugal pump of about 15 inches fan diameter, and when running it delivered a full stream of water with a suction of more than 30 feet, a figure which seemed so remarkable that it was several times measured for certainty. Our author states that the efficiency of centrifugal pumps is never guaranteed above 70 per cent., but the section on pumps is the least satisfactory part of the book in one sense, but the author has got together such information as is available, and endeavoured to present it in satisfactory form. In the section on turbines, a chapter is given of that latest motor, the Pelton wheel, the theory of of which is very simple, and the efficiency is high. There is also a chapter on the steam turbine. This is entirely descriptive of construction alone, and the arrangements made to secure steam tightness, but nothing is said as to the thermal data, and the reasons for or against the turbine as compared with high speed engines. Fans, also, are dealt with in Chapter XXXI., but there is not much said upon fan practice generally, nor is there a word on the question of the series running of fans which is sometimes called for. A short description of the Niagara turbines and of the hydraulic buffer stop close this rather mixed volume.

The illustrations, though a little rough, are clear and good. Some of them appear to be exact reproductions of illustrations in other books on turbines. There is, indeed, a remarkable similarity between many works on turbines which seems to show too little original knowledge or experience on the part of the authors.

CORRESPONDENCE.

Automatic Boiler Feeding.

In your issue of December 30th, 1898, you quote from a letter by Mr. E. G. Watson in the *Scientific American* on the question of "Automatic Boiler Feeding," in which the writer says, "The Weir feed pump is said to be wasteful in steam, but very reliable, and it is used for marine purposes, not because it is wasteful, but in spite of that defect." The writer certainly does not categorically assert that our pump is wasteful, but the fact that he quotes the hearsay statement implies that he endorses it to some extent. It has been said that if (to be Parliamentary) an erroneous statement is given 24 hours' start it will take a week to catch it, and as it is possible that some of your readers, in glancing over the article, might accept the second-hand statement as correct, we desire to point out that one of the features of the Weir pump on which we lay the strongest stress is that it is *not* wasteful in steam. Being a single cylinder pump it is much more economical than any duplex pump, on account of having fewer passages and clearance spaces to fill per stroke; and as the stroke is always constant, there is no chance of the clearance space being increased, as frequently happens in duplex pumps.

In comparison with any single-cylinder direct-acting pump, duty for duty, we are prepared to claim, as a result of our tests, that the Weir pump is not only the most economical pump in steam consumption on the market, but that the results obtained from this pump, working simple, are superior even to the latest published tests of compound single-cylinder pumps. In your issue of November 4th, a correspondent, in discussing this question of steam consumption, gives a test of one of our pumps which, we think, will compare favourably with any published tests we have yet seen. The steam valve of a direct-acting pump is undoubtedly its most important feature, and gives to it not only that quality of reliability with which Mr. Watson certainly appears to credit our pump, but also determines, to a large extent, the steam consumption, and it is the feature of our valve that it cuts off before the end of the stroke, and finishes the stroke on expansion—a characteristic possessed by no pump of the same class, and one which obviously makes for economy in steam consumption, besides favourably affecting the working of the pump in other ways. It is obvious, of course, that Mr. Watson does not speak from any experience of our pumps, and his remark seems to us extremely like an echo of a statement made in this country, the author of which has already acknowledged to us his mistake.

G. & J. Weir, Limited.

Re Shocks.

Mr. Ritter's experience, though interesting, cannot be new to a number of your readers, and perhaps ours may interest some.

On the night of November 2nd, 1897, we received a message that "the 'lectric was loose in the road, and all the horses were lepping out of their skin."

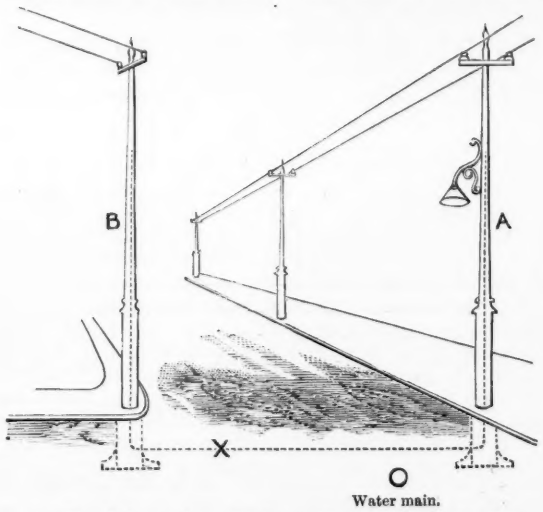
The following were the conditions:—

On the night in question there was no indication from the lights that anything was wrong, but a shock could be felt by anyone touching post A, or when standing close to it, the strength of the shock increasing in proportion to the distance the feet were apart.

The ground directly over the main for some distance was charged to a higher potential than that at either side.

This was tested by walking over the cable holding an iron rod, which was brought in contact with the road, at all distances from 1 to 6 feet in every direction. In other words, the body was placed in the position a horse's would be when crossing the main.

No shock was experienced at the post B, or anywhere within 14 to 20 feet of it, but very perceptible shocks were felt within 8 to 10 feet from A, the maximum (quite as much as was pleasant) being reached when standing



A, B, Wrought-iron posts; ×, Lead covered concentric cable direct in ground 20 inches deep.

at A, with the rod thrust into the road, at a distance of from 4 to 5 feet towards B. I estimated the difference of potential to be from 50 to 70 volts over about 3 feet of ground.

Examination disclosed the fact that a bad joint existed at the top of post B, the insulation being quite wet and soft. I may mention that the overhead wires are at a pressure of 100 volts alternating.

The explanation which I made at the time, and which I believe to be fairly correct, was as follows:—

"The fact that a fault was discovered on the top of post B, while the indication of it was only noticeable on the A side, I attribute to the two posts being in metallic contact by the lead covering of the underground cable, and the earth surrounding the B post was almost dry, while the earth sur-

rounding the A post was quite wet and its base was in close proximity to a large water main, forming, no doubt, a good conductor to some other part of the system."

Nine days later we had a somewhat similar experience, though occurring in a much more important district, and where there was no overhead at all.

I would be glad to give detailed description, but fear I have already trespassed too far.

No doubt Mr. Ritter will, before he reads this, have found that he is quite correct in his surmise, that there is a fault on the opposite main, and it must be a pretty healthy one, having passed 20 amperes for any length of time.

As regards the birds, if Mr. Ritter considers the high conductivity which his overhead main has, or the small difference of potential which there will be in, say, a mile length, he will easily realise how very small the difference must be in, say, a 1-inch length, which is perhaps about as much as a bird would bridge when perched on the wire.

Geo. Marshall Harriss,
Bray Township Electrical Engineer.

The Deposition of Copper.

Your correspondent, Mr. W. Gibbings, writing in your last issue on the above subject, is, I believe, correct in saying that the Anaconda Company has given up the process of squirting a series of jets on to a rotating cathode. But I think it is necessary to point out that this does not imply that the process is a failure by any means. The experiment referred to was made under a patent taken out in America by one Thofehrn, which is almost a word for word copy of Elmore's earlier patent for the same purpose.

I recently saw some tubes and sheets which have been produced under the more recent Elmore rapid depositing patents, which were most perfect in every respect. Sheets 26 W. G. deposited in 2½ hours, and copper tubes ⅛-inch thick deposited in 18 hours, at a voltage of less than 1 volt, are, I believe, the record for the modified Elmore process, which I understand was most favourably commented upon by Dr. J. Hopkinson just before he left for the holiday which unfortunately ended in his death.

I understand that in the new Elmore's process the burnishing device using agate or sapphire burnishers is still retained, as by its means, and in conjunction with the liquor impact, a tensile strength as high as 35 to 38 tons per square inch is obtained in the deposited metal.

James Stevens.

The Lancashire Electric Power Association.

Respecting the conference held to-day at the Manchester Town Hall for the purpose of organising opposition to the Bill of the above Association intended to be introduced to Parliament next Session. This Bill is to be opposed because it means a serious matter, and is causing much uneasiness and fear among those municipal authorities now supplying electric power. Why should a scheme that is to be a public benefit be met with such wholesale opposition from the various towns in Lancashire and Cheshire? Why not let the public benefit by the cheap production of electricity which this scheme will afford them?

If the municipal authorities now supplying electricity cannot produce it as cheaply as it will be supplied under this scheme, then let them stand on one side and allow their citizens to have the benefits of this scheme, and not oppose the Bill. It is an admitted fact that the cost of an article is less when made in large than when made in small quantities; so it is the case with electricity, as produced wholesale and cheaply under this scheme, from which the public are to benefit by such production; but the municipal authorities say, "What are we to do with the plant that has cost thousands of pounds?" Well, surely they do not expect the public and ratepayers to keep on paying more for electricity in order to keep municipal plant working when they can get it cheaper from someone else. Take the question on the fair business lines we meet in these days of keen competition. Say I sell an article for so much money, and a competitor sells a similar article for much less, the conclusion drawn is, that I must either be slow and behind the times or else making a big profit, and would the public take any notice of me if I asked them not to buy from my competitor. They would please themselves and naturally buy from the cheaper maker.

Take the case of a small district council whose rateable value is so small that they could not afford to spend the necessary money for electric plant, but who would like to have electricity in their midst, then such a scheme as proposed is the very thing for them, so why should the public, through their representatives, oppose this Bill that is to be of such benefit to them? They are only standing in their own light.

I notice this Association do not ask for any monopoly, so anyone and any municipal body may please themselves. I would ask the very persons who will go to Westminster to speak against this scheme one simple question, viz., If they had two mains side by side, one of them municipal electricity at, say, 7d. per unit, and the other Power Association electricity at, say, 5d. per unit, which of the two mains would they use if they had to pay for it out of their own pockets? Why not the municipal bodies stand by their merits? If they cannot compete, then let them retire and make way for public benefit and progress. They may well say this Bill must be watched, as it will mean serious consequences if passed.

T. Winstanley.

January 10th, 1899.

Elevator Accidents.

Your "Notes" of December 30th and January 6th on this subject are opportune, for they serve to draw attention to the fact that some inferior and untrustworthy lifts are on the market. A few weeks ago I witnessed the result of a lift smash at a large London printing works. The drum shaft had broken between the drum and the worm wheel, thus dropping the cage from the top of the building and wrecking the whole affair. Proper safety grips on the cage would have minimised the damage; still, much of the gear was faulty, and a faulty lift should be shunned. Fortunately no one was in the cage at the time of this accident.

Experienced makers like Messrs. Waygood and the "Otis" Company have fitted their electric lifts, from the earliest days, with every possible provision to ensure safety, and an accident of the nature described in your "Note" would be impossible with either of these makes.

The rope tappits, as you say, are not to be wholly relied upon. Messrs. Waygood provide a safety switch in the well at both ends of the travel, and this switch is knocked open by a projection on the cage should it over-run the floor by a few inches. The "Otis" Company effect the same result by a travelling nut on the drum shaft, which engages the "shipper-bar" wheel at the top and bottom of the travel and thus switches off. This method is better than the former, for it possesses the advantage of simultaneously applying the brake, and with it, too, there are no safety switches to close before the lift can re-start. Possibly Messrs. Waygood have brought this detail up to the standard of the "Otis" Company, for I believe there is little to choose now between the two, both are excellent.

Engineers should see that any other lift which they may be tempted to adopt on account of price, provides every safety detail which is to be found in the makes referred to, otherwise we shall hear of further trouble.

David Stevenson.

Cowper-Coles Cyclic Process and the Electric Refinement of Nickel.

I am sure those of your readers who take any interest in electro-metallurgy will agree with "Pertinax's" honesty even in small things is essential. This, however, does not seem to be the opinion of most of the present day inventions, processes, systems, &c., in connection with electro-metallurgy. The recent exposure of the Dumoulin patents by your correspondents one would have thought sufficient to act as a warning to people of this class from rushing into print with claims as to the advantages of their so-called inventions. In the case of Mr. Cowper-Coles's system, I am at a loss to know what novelty or utility he claims for it. As to the priority

for the invention of a disc cathode, neither Mr. Cowper-Coles, Dr. Tommasi, or Mr. Gibbings's "South Wales Smelting Works" have invented it; the earliest reference I can find to this form of cathode is in Elmore's patent 15,831, of 1886, but he does not claim the use of a disc *per se*, but its combination with other apparatus. I believe its use was claimed in connection with scrapers for depositing sulphur from alkali liquors by Elmore and Dr. Hurter (chief technical adviser to the United Alkali Company) jointly early in the eighties, and it was in use at the works of Messrs. Gaskill, Deacon & Co., at Widnes, for some time in a large experimental plant which was being operated under the direction of the Elmores at about the date above given.

F.

Notes on the Recovery and Refining of Nickel.

I notice in your issue of January 6th a letter signed "Pertinax," in which exception is taken to my "Notes on the Recovery and Refining of Nickel," which appeared in a recent number of the ELECTRICAL REVIEW. As I always welcome criticism and am anxious to profit by it, I have studied "Pertinax's" letter in the endeavour to discover wherein I have offended, and I find that his indictment against me resolves itself into two counts:—

1. That my article did not add anything to his knowledge.
2. That I have quoted facts without saying whence I derived my information.

In reply to Count 1, I would point out that my short paper bore the title of "Some Notes on the Recovery and Refining of Nickel," and purported to be merely a collection of some interesting facts connected with the subject; the result of the experiments of others. The article did not profess to disclose any new and startling discoveries.

The second count appears to me somewhat ludicrous, for in it "Pertinax," with great solemnity and at considerable length, accuses me of nothing more serious than that I have spoken of some fairly well-known matters of fact regarding the methods followed by Hoepfner, Askerman, and others, without saying from what particular books and journals I have gleaned these facts. If in this I have erred, surely "Pertinax" is equally deserving of blame, for in his letter —the very letter in which he finds such grave fault with me —he refers to the death of Queen Anne, and culpably omits to add a footnote to inform us that his knowledge of this fact is derived from "So-and-so's" "History of England."

Sherard Cowper-Coles.

Imperial Cable Scheme.

With reference to Sir Sandford Fleming's all-British cable scheme which you commented upon in your two last issues, it may interest you and your readers to know that in the spring or summer of next year (1900) I propose to connect up Great Britain with her colonies, and all extra-European foreign countries, by a new wireless telegraph system of my own invention, and succeed in reducing the word rate to all distant parts of the world to 2d. to 5d. per word only. Mr. Joseph Chamberlain, Secretary of State for the Colonies, was informed of my plans and routes several weeks ago. I anticipate it will take me at least five or six years' work to complete the above difficult task. It would be essentially an all-British telegraph system.

Thanking you for the insertion of the above.

Geo. H. Smith.

37, Daniel Street, Cardiff.

I may say I am open to supply you with particulars as regards the route, &c., and working arrangements (excepting the invention itself) of the proposed wireless system for £2 2s., if desired, and which could be rewritten up by you to form a special article.—G. H .S.

[We commend our correspondent to the "wild cat" genus.—EDS. ELEC. REV.]

Electric Light at the Vatican.—The *Daily Chronicle* Rome correspondent says that trials of electric lighting have been made at the Vatican, notably in the Raphael galleries. The whole of the Vatican will be lighted by electricity in a fortnight's time. This is being done by special desire of the Pope.

FLY-WHEEL STRESSES.

SOME tests on small model 15 and 24-inch fly-wheels have been made by Mr. Benjamin, M.Am.Soc.M.E., with a view to show at what velocity a cast-iron wheel may be considered safe. Mr. Benjamin ran a number of wheels until they burst, and the result showed that a solid cast wheel, *i.e.*, with no rim joints and with six arms would run up to 430 feet per second, and develop a stress nearly equal to that of the test pieces from the same ladle, though some wheels showed results as low as 361 feet per second. Nominally, therefore, a wheel at the standard velocity of 100 feet per second may be counted as having a safety limit in respect of rotation speed of 3½ to 4. As regards its actual margin of tensional stress the factor of safety is, of course, equal to the square of the rotational factor, though this should be kept out of sight, seeing that the rotational speed if doubled will quadruple the tension. The lesson taught by the experiments is that joints in a fly-wheel rim must be avoided. A jointed wheel failed at only 192 feet velocity, and a joint midway between the arms may be compared to a joint at the middle of a girder. There is very little known of fly-wheels. Large wheels do occasionally burst, but there is probably no evidence to show their velocity at the time. But of late years bursts have become rather too common in America. Hence the present tests, which point clearly the importance of sound casting and continuous rims. In a built up wheel it is difficult to arrange the bolted joints in a satisfactory manner.

The common method in the days when large mill engines were geared and fly-wheels only ran at about 50 feet per second was to hold the rim segments to the arm ends by a large headed dowel bolt secured to the arm, which was hollow to receive the bolt, by a through cotter. The toothed rim outside this was held by dovetail head bolts, slipped laterally into lugs cast on the toothed rim, the bolts passing through the rim and through the arm head also, the arms being cast with a T head, to allow of this double security. The main dowel bolt gave no centrifugal strength. The wheel did not burst, because the rim segments acted as girders for their own bending stress, and the arms withstood the tendency of the rim to fly off.

With the more modern rope rim and speeds for 80 to 90 feet per second, the rim segments are usually bolted together midway of the arms by internal flanges. This is the only possible way of effecting the bolt joint, but the system is faulty; the bolted joint should be placed as near as possible to an arm, so as to remove it from the place of most severe bending stress. Attention should also be given to the bolts. These must not be proportioned to equal strength with the cast-iron rim, but they should be of such a cross sectional area that their extension under stress shall be the same as that of the cast-iron they connect.

The margin of strength possessed by many large rope rims is, we fear, most undesirably narrow, because there is a large area of cross section adding to the centrifugal tension, and of no account in resisting this, while the bolting flange, placed midway between arms, is badly placed. Placed near an arm the bolts would be in tension as they should, and if well fitted, the cast-iron rim itself would be in compression at the joint.

For mere fly-wheels without toothed rims, the arm ends were made slightly fan-shaped, and the rim segments were bolted sideways upon them, and half sunk to receive the fan piece, so that when complete the whole rim was dovetailed together, and no rim piece could fly out. Any tendency to fly outwards simply tightened the whole rim, and the wheel could only fail if a segment broke across. Centrifugal strength was only obtained, though the security of the bolts, which did not usually fit a turned fit in the holes. Sometimes the rims of fly-wheels were given a circumferential continuity by means of dowel bolts of wrought-iron secured to the rim segments by cotters in the same manner as the segments were held down to the arms, and the arms again to the boss. By securing the ends of the segments to each other the breaking stress of the segment as a beam is increased, for, in a sense, the segments are thus made into continuous girders. This, of course, strengthens them against breaking in the middle, and increases the possibility of the arm end being first to give way. Considering the difficulties in the way of an absolute reliable continuity of the rim, it is open to question whether after all it would not be better to increase the number of arms so as to support the rim at a larger number of points, and to make the arms of wrought-iron, and place these tangential to the boss on the bicycle wheel principle. There are three principal stresses to be provided for in a fly-wheel, namely, that tending to break the rim between the arms, that tending to pull off the arm ends, and that which tends to break the arms across, this last being only brought into action to a serious extent by sudden changes of load. In a continuous rim there is the force tending to pull the rim apart by rim tension; but when this force can act by reason of continuity, the arm end tension will be eased off, for there can be no arm tension until the rim begins to stretch.

Seeing that cast-iron is more extensible under load than is wrought-iron, even a continuous rim with wrought-iron arms would receive support from the arms sooner and to a larger extent than it would if the arms also were cast. Hence, with wrought-iron arms the actual stresses could be better provided for, and the rim could be subdivided to any necessary extent until the wheel, as regards stress, could be treated simply as so many lumps of metal swung round at the end of so many tension rods, which could be closely calculated for the maximum stress likely to come upon them. We have seen a good number of large fly-rims and been impressed with the idea that what has been sought has been merely a huge cast-iron circle, all idea of stresses being evidently absent from the mind of the designer. Good enough in the past, such designs are unfitted for the practice of to-day.

In some of the wheels tested the rims were jointed by means of links shrunk over lugs cast on the sides of the rim, and also in cases on the underside of the rim. These linked joints were by far the best and far surpassed the bolted flanged joint. Indeed, though nominally weaker than the solid rim, the wheels thus jointed brake in the solid rather than in the joint. By means of similar links and an internal cottered dowel bolt, it appears probable that a very fairly satisfactory joint could be obtained. For really serious high-speed work, in which abnormal stresses are to be provided against, the wire-wound wheel, with little useless metal to add to stress, presents an ideal system even though at a great cost.

SMOKE PREVENTING DEVICE.

Industries and Iron devotes no fewer than 15 columns in a recent issue to smoke preventing, the object apparently being to lead up to a description of a device which is professed to have been casually discovered when looking through some patent specifications. From the explanation and illustrations the device is nothing else but a means of admitting air above the fire, as first devised by Wye Williams, whose little book—one of the old Weale's series—might be read to-day with advantage by many steam users. The new device which our contemporary is booming so strongly has very little about it that is novel. The principle is old enough and correct enough, but its carrying out is no better than that of many other similar devices, and lacks the important feature of automatic action. We have very little faith in any air admission device which is not automatic in its opening and closing by the act of opening and closing the fire door for charging. Experience has taught us that stokers cannot be trusted to attend to the air slides. They will do so while the apparatus is new and fresh and under regular inspection from the office, but as soon as it ceases to specially interest the "guvnor," so soon does the stoker cease to use it regularly. Moreover, when he does use it regularly, he will frequently delay the opening of the grid for several seconds after closing the fire door, and this is just the time it should be opened. Correctly speaking, the air admission should start fairly wide open as the door is closed. It should then open a little wider, and gradually close from that point. With a regulator of the Louvre or Venetian blind type, this effect is obtained by first opening the slots past the horizontal so that they partially close the airway. Then, as they move to the closing position, they become horizontal, giving maximum inlet area, and from that point they close gradually, the speed and duration of closing being regulated by some form of cataract, clockwork, or slow moving shaft actuated by the main engine and adjustable to suit the weight of fuel fired at each charge. The mistake with many schemes of air admission is that too much is admitted and in an ill-directed manner. Too often air is admitted in a bulky stream—we saw one example recently where an air inlet of 18 inches × 6 inches was given. The proper system, as pointed out by Wye Williams, is to admit air in fine streams, so that it may be well intermingled with the gases. If in excess it only uselessly cools down the furnace. Properly arranged, it is possible to effect an economy of fuel by burning bituminous fuel with air admitted above the fire. There is not a very large loss due to smoke, and there cannot be a huge economy in preventing it, but there can be a huge economy between burning bituminous coal and burning Welsh coal at double price. We see nothing in the invention so strongly advocated by our contemporary, though it may be correct, to demand such advocacy as though nothing similar had ever been tried or was in existence, while we do see several points in which the apparatus is at fault, one of which we have noted above.

BUSINESS NOTICES, &c.

Announcements.—Mr. F. H. Lindsay, the present manager and electrician of the National Telephone Company, Limited, for N.W. Wales, has entered into partnership with Mr. E. Browning, mechanical engineer, for the purpose of carrying on the business of electrical, mechanical, and consulting engineers, at Bangor. The firm has already secured an important contract for the electric light installation at Messrs. Dixon & Co.'s new slate works, at Port Penrhyn.

Mr. C. C. Wardrop informs us that he and Mr. Whitaker have dissolved partnership. Mr. C. C. F. Monckton, late engineer and manager of Messrs. Boustead Bros., electrical department in Ceylon, has joined Mr. Wardrop. We understand that great progress in electrical work was made in Ceylon under Mr. Monckton's management, and all the principal Government buildings, hotels, and merchant's offices in Colombo have electric light and power from Messrs. Boustead's central station. Messrs. Monckton and Wardrop will henceforth practise as civil and electrical consulting engineers, under the title of Wardrop & Monckton, at 1, Army and Navy Mansions, Victoria Street, Westminster.

Mr. William Scholes announces that he is now carrying on business as before at 85, Corporation Street, Manchester, under the name of Scholes & Son, engineers and contractors.

Annual Dinner.—The employés of the Winchester Electric Light and Power Company, Limited, held their annual dinner on 31st ult.

Electrical Wares Exported.

WEEK ENDING JAN. 3RD, 1898.	£	s.
Alexandria. Teleph. mat.	109	0
„ Teleg. mat.	34	0
Albany	38	0
Amsterdam	85	0
Antwerp	65	0
„ Elec. fuse ...	410	0
Auckland	20	0
Bangkok	35	0
Barcelona	25	0
Bermuda. Teleg. cable	95,000	0
Bombay	40	0
Bordeaux	20	0
Borneo	1,206	0
Brussels	396	0
Calcutta	313	0
Cape Town	1,095	0
Colombo	36	0
Copenhagen	96	0
„ Teleg. mat.	54	0
Delagoa Bay	36	0
Demerara	135	0
Durban	506	0
East London	822	0
Gibraltar	24	0
Gothenburg	24	0
Halifax. Teleg. mat. ...	158	0
Hamburg	33	0
Jamaica. Teleg. mat.	174	0
Kurrachee	150	0
Lyttleton	408	0
Melbourne	52	0
Montreal	30	0
New York	10	0
North Atlantic. 3,000 lbs. Teleg. cable	—	
Ostend	85	0
Port Said	101	0
Rio de Janeiro	10	0
Rotterdam	33	0
Stockholm. Teleg. mat.	24	0
Sydney	1,186	0
„ Teleg. mat. ...	133	0
Turk's Island. Teleg. mat.	15	0
Vera Cruz	69	0
Wellington	83	0
Yokohama	576	0
Total	£103,956	0

WEEK ENDING JAN. 3RD, 1899.	£	s.
Adelaide	1,593	0
Barcelona	10	0
Bombay	24	0
Bordeaux	17	0
Calcutta	108	0
Cape Town	58	0
Christiania. Teleg. wire	387	0
„ „ cable	57	0
Colombo	89	0
Durban	164	0
„ Teleg. mat. ...	2,405	0
Hamburg	8	0
„ Teleg. mat. ..	110	0
Melbourne	105	0
Monte Video	536	0
Otago. Cable wire ...	250	0
Port Elizabeth	135	0
„ Pirie	50	0
Rosario	561	0
Santos	12	0
Spezzia	548	0
Sydney	170	0
Trinidad	70	0
Yokohama. Elec. cable	320	0
Total	£7,787	0

Electrical Wares Exported.

WEEK ENDING JAN. 10TH, 1898.	£	s.
Amsterdam	125	0
Barcelona	25	0
Beira	50	0
Bombay	422	0
Cape Town	166	0
Durban	112	0
Fremantle	1,640	0
Hamburg	50	0
Lisbon	30	0
Malaga	50	0
Malta	68	0
Marseilles	85	0
Melbourne	323	0
Monte Video	36	0
New York	25	0
Ostend	35	0
Paris	162	0
Perth	49	0
Port Elizabeth... ...	450	0
Rangoon	650	0
Rouen	82	0
Santander	29	0
Shanghai	13	0
Stockholm	470	0
Sydney	336	0
Teneriffe. Teleg. cable	3,625	0
Trinidad	22	0
Yokohama	737	0
Total	£9,867	0

WEEK ENDING JAN. 10TH, 1899.	£	s.
Adelaide	500	0
„ Teleg. mat. ...	907	0
Buenos Ayres. Teleg. mat.	750	0
Cape Town	680	0
Chinde	75	0
Christiania	112	0
Copenhagen	50	0
Durban	20	0
„ Teleg. mat. ...	2,314	0
Fremantle	65	0
Gibraltar	780	0
Hamburg	65	0
Lyttelton	24	0
Madras	300	0
Melbourne. Teleg. mat.	270	0
New York	8	0
Ostend. Electric light wires	51	0
Perth	26	0
Stockholm	30	0
„ Teleg. mat.	885	0
Sydney	304	0
Yokohama	173	0
Total	£8,397	0

Foreign Goods Transhipped.

Bombay ...	...	...	£40 0

Annual Soirée.—The annual soirée of the employés of the Sunbeam Lamp Company, Limited, was held on Friday evening, at Gateshead, when about 200 were present. In the unavoidable absence of the managing director, Mr. Edmundson, the gathering was presided over by Mr. T. J. Grainger, secretary.

"Applications of Electric Power."—The British Thomson-Houston Company make a very strong feature of the preparation of collections of illustrations of the many works carried out by them. Some time ago we noticed an excellent book of views of electric tramways which had been equipped on their system, and we are now called upon to review an equally well illustrated album containing a collection of illustrations of electrical apparatus of their system in use for the operation of pumps, hoists, cranes, and various other machinery. We have no doubt that this album will be prized by many an electrical engineer as giving excellent pictures to illustrate some of the more important uses to which electricity is put in its application to heavy engineering work. The book does credit to all who have had any part in its production.

Auction Sale.—Messrs. Percy Huddleston & Co. will sell by auction (in *re* City of Bath Electric Lighting and Engineering Company, Limited, in voluntary liquidation) on January 19th, certain electrical plant, comprising a number of dynamos, arc and incandescent lamps, switches, and other electrical accessories, measuring instruments, cables and wires, gas engines, &c., &c.

Bankruptcy Proceedings.—The Official Receiver for the Rochester and Maidstone District (Mr. R. T. Tatham) on the 4th inst. opened the public examination of Thomas King, who has traded as an electrical engineer at St. Peter Street, Maidstone, and prior to that at 29, Western Road, Brighton, and after a lengthy examination the proceedings were adjourned for a month (February 1st). His total liabilities now scheduled amount to £2,497 19s. 6d., of which £2,103 13s. 5d. is expected to rank for dividend. The assets are stated to produce £1,109 11s. 11d., and the deficiency is given at £994 1s. 6d. The examination was conducted before Mr. Registrar Warner. Mr. Frederick William Davis, chartered accountant, Finsbury Pavement, has been appointed trustee of the debtor's estate. The first meeting was held at Bankruptcy Buildings, Carey Street, on December 22nd last, when the trustee and a committee of inspection were appointed. There are 134 creditors, including several London electrical firms. Upon the adjournment asked for by the trustee being granted, the Registrar ordered debtor to file an amended deficiency account covering the period of two years prior to the receiving order, to be filed within 14 days.

Dissolutions of Partnership.—Messrs. E. J. Mather and A. A. Mather (Mather Bros., plumbers, gas and electrical engineers, Caledonian Road, N.) have dissolved partnership. Mr. A. A. Mather will attend to debts.

Messrs. C. C. Wardrop and C. A. V. Whitaker (Wardrop and Whitaker, electrical and civil engineers, Army and Navy Mansions, Victoria Street, S.W.) have dissolved partnership. Mr. Wardrop will attend to debts.

Liquidation Notices.—The Northern Counties Electric and Motor Company, Limited, of Halifax, decided on 23rd ult. to wind up voluntarily, as by reason of liabilities they cannot continue business. Mr. J. Robinson, Lightcliffe, York, was appointed liquidator.

The Improved Incandescent Electric Lamp (Foreign Patents) Syndicate is to be wound up voluntarily. Mr. R. Ballard, of 20, Jewry Street, E.C., has been appointed liquidator.

At meetings held on December 20th and January 4th, the Sheffield Electric Light and Power Company decided to wind up voluntarily. Messrs. G. Franklin and J. Gamble being appointed liquidators.

The London and Hampstead Battery Company, on December 29th and January 5th, passed resolutions winding up voluntarily, and appointing Messrs. R. J. S. Beeton and S. T. Turtle, liquidators.

Books Received.—"The Automotor and Horseless Vehicle Pocket-book." 1899. 1s. Published by the *Automotor and Horseless Vehicle Journal*, 62, St. Martin's Lane, W.C.

"Lockwood's Builders' and Contractors' Price Book." 1899. London: Crosby Lockwood & Son. 4s.

Branch Office.—The British Thomson-Houston Company, Limited, have opened branch offices at 21, Lincoln Place, Dublin, in connection with their contract works in Dublin, and for various electrical business. Mr. Arthur Jacob is resident engineer.

"The Builder."—The New Year issue of this journal favours its readers with a large number of supplements, which are far more bulky than the paper itself. There is a large useful map of the County of London, with a note of the names of all district surveyors within the area, and the numerous plates consist of very excellent pictures of buildings and structures of architectural interest in various centres.

Changes of Address.—On account of increased business in the Midlands the Edison & Swan Company have removed their Birmingham offices to larger and more convenient premises, at the International Exchange Buildings, Edmund Street, Birmingham. They are there fitting up a spacious showroom for the display of electroliers and brass fittings generally.

The Prism Globe Syndicate, Limited, have removed from Dashwood House, E.C., to 57 and 58, Chancery Lane, E.C.

The C.T.C. and Manufacturing Company, Limited.—We are very glad to hear that since Mr. Menzies, the general manager, has taken the active management of the works of the above company, and been in Coventry on all but board meeting days, matters generally have considerably improved. We understand that many changes have been, and are being made, both in the "personnel" and in the methods of producing the many parts, with advantage; orders are in hand to such an extent that working 60 hours a week is insufficient to satisfactorily cope with them. The new year has brought new promises, which it is to be hoped may be fulfilled; but the "white elephant" of over-capitalisation has unfortunately at present to be reckoned with, and is a serious handicap to dividend earning. The company sends us an appendix to its 1897 catalogue describing some new transmitters, and other telephone accessories.

Dividend.—The *London Gazette* contains notice of an intended dividend in the case of John Dewhurst, electrician, &c., of North End Road, West Kensington. The last day for receiving proofs is January 21st. Trustee, Mr. E. Leadam Hough, official receiver, Bankruptcy Buildings, W.C.

Electrical Accessories.—Messrs. Hale Bros., of Upper Thames Street, E.C., have sent us specimens of each of the following, which are placed on the market by them. The "Hale" dry cell has, we are informed, an E.M.F. of 1·55 volts and a very large output. It is claimed to be unaffected by temperature and may be kept any length of time without diminution of strength. The terminals enable an easy connection to be made, and as the whole is contained in an earthenware jar there is no fear of corrosion or of the salts eating their way through. In the "W. D. H." lampholder the principal feature is an arrangement by which the wiring can be effected without unscrewing the case—20 of them can be fixed in the same time as one of the ordinary type. All that is necessary to be done is to loosen the terminal screws, which can be easily done with a small screw-driver or knife, and the wire is then passed through the holes in the porcelain and the screws tightened down again. The whole of the porcelain is in one piece so there is no possibility of breakage in fitting, and the design is claimed to render short circuits or contact between loose wires and the brass case impossible. This lampholder, as well as the cell mentioned above, is made in England. Messrs. Hale's "Crown" steel conduit system is one in which enamelled steel tube is used to replace wood casing. The tubing can be installed by inexperienced labour since all mitreing and screwing on of covers is avoided. All necessary joints, bends, &c., are provided ready-made. It is claimed that the "Crown" conduit affords complete mechanical and electrical protection. The "Patent Joint" forms a connection for junction boxes, tees, and tubing which is damp and waterproof, and the tubes can be imbedded in plaster the same as speaking tubes and gas tubes. The tubes being made of steel they can be made of a light gauge so that the outside diameter requires to be but a little larger than the wire used, which for surface work is a great consideration. They can be fixed with ordinary crampet hooks or saddle straps. The tube and connections being enamelled require no further painting.

Electrical Engineering in Italy.—We learn, says *Sell's Commercial Intelligence*, that a company has been formed in Milan, with a capital of $80,000, to be known as La Societa Italiana di Applicazioni Electriche. This company is to acquire and carry on central electric lighting stations at Aguila, Pontedera, and Chioggia, and also the projects for several electric tramways. Another company has just been formed at Vicenza to establish a central station for the electric lighting of the towns of Breganze and Sandrigo. The Helios Company, of Ehrenfeld, Cologne, Germany, is negotiating with the provincial authorities of Brescia for the construction of several lines of electric tramways in that province. Siemens & Halske, of Berlin, have recently secured a contract to establish a central electric lighting and power station in the town of Perugia. Other contracts of less importance, but involving expenditure of some consideration in the engineering line, have of late been made in Rome. German merchants, it is said, are deriving a great deal of benefit from the industrial progress of Italy.

Electrical Trade with Egypt.—The *Consular Journal* says that there is an increasing demand for electric light fittings of all kinds. The electric light is now being employed largely in private houses and public establishments, and its use is likely to be considerably extended.

Electricity in Brussels.—It appears from a recent report by Consul Roosevelt, who represents the United States in Brussels, that the employment of electricity for illuminating purposes is rapidly extending in that city. "The lamps, as well as nearly all other electrical supplies, are of German origin. Holland supplies a few, and England a fair percentage of the electrical wires employed. American lamps, and other electrical goods, are exposed for sale here, and are conceded to be superior to those imported from Germany, France, and England, and with a proper effort, the trade in these goods could be greatly increased. There is an excellent opening in copper wire, insulated wire, large cables, and arc lamps. An interesting installation of electric transmission by water-power has recently been completed by the utilisation of the River Etsch for the benefit of the towns of Bozen and Meran. The sources of the Etsch are at a great height, the Reschen Lake, which is situated some 5,200 feet above the level of the sea. At the place where the installation has been erected the fall of the river is 630 feet, over a distance of about 1½ miles. So far, 6,000 horse-power have been utilised, and a similar quantity can be made available at the second fall. The power will be used for electric light at an extremely cheap rate, for industrial purposes, probable electric railways, &c. The course into which the water is conveyed has a length of about 6,000 feet, a tunnel has been made through the rocks of 1,730 feet in length, and at the end of this is a reservoir, with a capacity of 1,335 cubic metres. From here the power conduit, 12 feet in diameter, has been blasted almost vertically in the rock. It ends in the chamber from which two steel tubes, about 5 feet in diameter, lead to the turbines. The tubes are, for the length of 110 feet, inserted in the rock, and laid in concrete. From these tubes there are three outlets from each tube, which lead the water to the turbines, which are after the Portial Gerard system, and of 1,000 horse-power each at 320 revolutions, the consumption of water being 1·4 cubic metre per

second, with a utilised fall of about 230 feet. The dynamos are direct coupled with the turbines and generate currents of 10,000 and 3,600 volts. The connection with Bozen has a length of 22 miles, and the one to Meran of three miles. They are overhead, supported by 33 feet high poles, and with a tension of 100,000 and 3,600 volts respectively. On entering Meran, the current is conveyed through two cables to the distributing station, from which, by means of underground high tension network, it is conveyed to the transformers and reduced to 115 volts. The same is the case at Bozen, where the current, however, first is reduced from 10,000 to 3,600 volts. The cost of the whole installation amounts to about 1,500,000 florins, and it is likely to prove a very remunerative investment."

English Electrical Plant for Russia.—The *Rugby Advertiser* says that Messrs. Willans & Robinson have just completed an important contract in Russia, and at midday on Tuesday last week a whole train of upwards of 30 trucks, containing considerably over 100 tons of engines and dynamos, forming the whole of the contract, was drawn out from the Victoria Engineering Works, to be taken across to Hull for shipment.

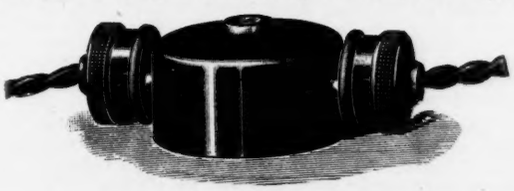
Extension of Premises.—Mr. G. Braulik, of Upper Thames Street, E.C., is compelled by increased trade to enlarge his premises. Extensive showrooms are being fitted up, and a largely increased stock will be kept.

The Far East.—A financial daily quotes from the *East Asiatic Lloyd* that the agents of Messrs. Siemens & Halske have secured a contract for the construction of an electric line between Matschiapu and Peking, which is already to be in work in March next. The same firm is said to have been entrusted with providing the electric light for Peking.

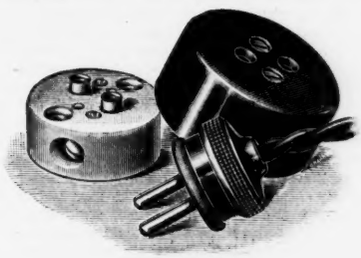
First Meeting of Creditors.—A first meeting of creditors was held under the failure of J. E. Liardet, inventor and patentee, 16, Hyde Park Gate, on Thursday last week at the London Bankruptcy Court before Mr. H. Brougham, Official Receiver. It appeared that the debtor had been engaged in experimental work in connection with inventions and patents, and had derived an income of about £500 a year in respect of the sale thereof. He had failed on a previous occasion about 10 years ago, from which proceedings he obtained his discharge. No statement of affairs was filed, but proofs amounting to £8,458 were tendered. The assets comprised the debtor's interest in electrical accumulators, water motors, and electric motor cars, in respect of which various patents had been taken out. He asserted that if properly worked and perfected, the whole of those patents should prove to be worth considerably more than 20s. in the £. The failure was ascribed to expenditure in completing work in connection with the patents. It transpired that the debtor had only recently returned from Cairo, where he had been engaged on behalf of a syndicate, with a view to securing certain valuable concessions on the Nile. Mr. C. E. Soames, who attended on behalf of the debtor, said that the receiving order was taken by accident, and an application to set it aside was pending. The debtor was desirous of submitting a proposal to his creditors, and he asked for an adjournment to enable him to do so. The creditors agreed to this, and the meeting was adjourned till February 3rd next.

An adjourned first meeting of creditors was held on Friday last under a receiving order made in the case of Edward Baldwin Pym, electrical engineer, Bramham Gardens, South Kensington, and late of Scarborough, at the London Bankruptcy Court, before Mr. A. H. Wildy, Official Receiver. No accounts were filed, and the amount of the debts and assets did not transpire. The chairman stated that since the last occasion he had heard of the debtor, who was at Burnham, Somersetshire, and stated that he was without the means to attend in London. He (the chairman) had communicated with the Official Receiver of the Taunton district, who had arranged for the debtor to attend upon him for preliminary examination. On the last occasion it was stated that the debtor was abroad. Mr. Somerville, who attended for the debtor, said that at the last meeting it was stated that the debtor was at Monte Carlo. That was incorrect, as the debtor had never been there. The chairman said it appeared that the debtor was entitled to a certain income which was alienable upon bankruptcy, and in the interests of the creditors, he thought it would be best to further adjourn the meeting in order that full information might be laid before them. The meeting was adjourned until the 30th inst.

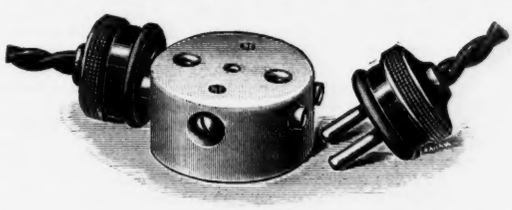
High Voltage Fittings.—Mr. A. P. Lundberg, of Kingsland, sends us a sample of his new "Universal" high voltage wall connection without fuse terminals, fitted with "Ridge" type of cover, as per illustration. The principle of construction is claimed to be quite novel. All the metal parts are thoroughly protected against possible leakage of current, being well embedded in the porce-



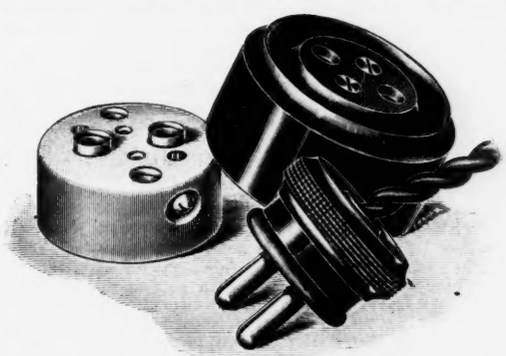
lain in such a way as to render the insulation as perfect as possible. To provide a proper insulating bridge between the ends of the contact tubes when circuit is broken by withdrawal of plug, Mr. Lundberg still retains the method he has adopted for several years, viz., to countersink holes in the roof of cover to admit the ends of contact tubes, which he considers the simplest, neatest, and most satisfactory method, and the length of contact pins is kept down to reasonable limits. As usual, the plugs and sockets are of similar gauge, and consequently interchangeable with those supplied since 1884 and with each other. The construction is held to be simplicity



itself. The contact tubes are of extra stout metal, and are pierced at their base by horizontal holes; through these pass studs screwing into the pillar terminals and clamping them solidly into contact with the contact tubes. We also illustrate a sample of the "Dot" wall connection similarly arranged for high insulation. The diameter has been reduced a trifle owing to the improved construction and absence of fuse terminals. Mr. Lundberg also sends a sample of the "Dot" twin wall connection. As the original introducer of twin socket



plugs several years ago, the use of which enabled the user to take two branches from one wall connection, either for temporary or permanent purposes; he has noticed how the demand has increased, and felt justified in designing a special pattern to fulfil these requirements, which would be neater in appearance, and have less of a makeshift look than the present method. Side entering plugs have been



adopted so that the article stands but a minimum distance from the wall when fixed. It is stated that considerable economy will be found in their adoption. The plugs are interchangeable throughout, but at present the article is only made to suit the "Dot" gauge. Mr. Lundberg reports 1898 as an extremely satisfactory year, and 1899 has already produced some good stock orders.

Industrial Exhibition.—The members of the Article Club are shortly to organise an industrial exhibition of the processes and methods and appliances employed in the various branches of industry with which their establishments are connected. The proposal is explained in this week's *Commerce* in an interview with Lord Suffield, the president of the club.

Langdon-Davies Motors.—The proprietors of the *Newcastle Daily Journal* have just introduced a number of Linotype composing machines. On the suggestion of Messrs. Ernest Scott and Mountain, Limited, who carried out the work, Langdon-Davies alternating current motors were installed for driving the machines.

The Large Power Schemes.—Our financial contemporaries have given some details of the powers sought under the Bills now being promoted by the large electric power companies, brief mention of which has been already made in these columns. Under the style of the Lancashire Electric Power Company, power is sought to incorporate an undertaking for the purpose of providing electrical generating stations for the production, storage and distribution of electricity within the area of the company's supply. The works to be constructed under these powers comprise four central or principal stations on certain lands set out in a schedule to the Bill in the parishes of Aspull, Parr, Little Lever, and at the western corner of

the Trafford Park estate, Barton-on-Irwell. At these central stations the company proposes to manufacture and sell everything necessary for distributing energy for lighting and other public and private purposes, and for converting the same into motive power, heat or otherwise. The capital of the company is to be £3,000,000 in £10 shares, but with power to divide these shares into preferred half shares and deferred half shares. Upon this capital it is proposed to raise a further £1,000,000 by the creation of debenture stock, but it is provided that the compulsory powers of the company shall not be exercised until not less than £100,000 of the capital shall have been subscribed under contract. The first directors are to be Mr. W. P. J. Fawcus, Mr. F. E. Gripper, Mr. W. B. Hopkins, Mr. N. Scott Russell, Mr. G. B. Samuelson, Mr. R. P. Sellon and four other persons to be nominated by them. The area of supply is fully detailed in the Bill, but, speaking generally, it includes Lancashire and the northern parts of Cheshire. By Clause 34 it is provided that nothing in this Act shall confer on the company the exclusive right to supply energy within the area of supply, or to hinder or restrict any other body or person from supplying or increasing their present supply of energy within the same area, nor shall the company at any time hereafter, by reason of any competitive supply, be entitled to any compensation for alleged vested interest. The profits of the company are to be limited to 10 per cent. subject to a sliding scale similar to many other companies.

A Bill to provide for a central electrical generating station for the supply of electricity within certain portions of Leicestershire, Warwickshire, and Derbyshire has also been deposited. The Bill proposes to incorporate and confer powers upon the Leicestershire and Warwickshire Electric Supply Company to acquire about 35½ acres of land at Hinckley, in Leicestershire, on which to erect a huge generating station for the distributing of electricity direct from the company, or in bulk to any corporation within its area of supply, "provided that, notwithstanding anything shown upon the deposited map, the company shall not supply any part of the County of Nottingham." The share and loan capital of the company is to be £1,000,000, of which £250,000 may be raised on mortgage. The profits of the company are to be fixed at 10 per cent., but subject to an increase of 5s. per cent. for every one-tenth of 1d. per unit at which the "energy" may be supplied below the standard price of 2½d. per unit, The Bill further provides that "nothing in this Act shall be construed to confer upon the company the exclusive right to supply energy within the area of supply, or to hinder or restrict any other body, company, or person from supplying or increasing their present supply of energy within the said area, nor shall the company at any time hereafter, by reason of any competitive supply, be entitled to any compensation for alleged vested interest in respect of any of the powers conferred upon it by this Act."

Lists, &c.—The Electrical Power Storage Company are circulating sheets for substitution in their catalogue, giving particulars of their K.W.S. cells, showing an advance in prices.

Messrs. John Gibbs & Son, of Liverpool, have issued a list of a direct-driven electrical dust-proof air-propelling and ventilating fan, with enclosed motor.

The Prism Globe Syndicate send us a list of their globes for electric light fittings.

The Cape Asbestos Company, Limited, of Minories, E.C., has issued a useful desk blotting pad, with calendar for 1899 printed in the left hand corner.

Lockwood's Builders' and Contractors' Price Book.—In the 1899 edition of this annual, just published, the editor remarks upon the unprecedented high prices for material and labour which have prevailed for more than a year in the building trade. The cost of labour has risen very greatly, owing to the policy of the trade unions in restricting the amount of labour given in return for wages, with the result that master builders, in the consequent uncertainty as to what particular jobs of work will really cost them, have been led to raise their prices higher than they otherwise would have done. The book contains an extensive section dealing with electric lighting as it affects the builder. This has been specially revised and added to since the last issue.

New Books.—We are asked to state that Messrs. Whittaker & Co., of White Hart Street, Paternoster Square, E.C., are the recognised agents in England for the two books, "Wiener's Dynamo Electric Machinery" and "Dictionario Technico," reviewed in our last week's issue.

New Premises.—Messrs. W. H. Baughan & Co., of Charlbury, are about to open premises at 8 and 10, London Street, Reading, as manufacturing electricians.

A New Copper Company.—The prospectus of the Mount Lyell Comstock Copper Company has been issued. This company has been formed in order to purchase and work copper mines situated near to the North Mount Lyell Company's mine in Tasmania. The property covers 80 acres, and is directly on the line of the lode worked by the latter company. Prospecting tunnels have been driven in several directions through the property, and the position of the chief body of ore located. Assays of this ore have shown it to contain 6 to 7 per cent. of copper, and 1¾ oz. precious metals per ton. The average metal value of the ore at *present* prices is therefore £4 16s. per ton. Mining, smelting, and freight charges are estimated to amount to £2 per ton, so that a profit of £2 16s. per ton of ore mined may be looked for—*as long as present prices last.* The new company has four directors of the North Mount Lyell Company upon its London board, and the ore raised will be smelted by the latter company in their recently erected plant. The capital of the Mount Lyell Comstock Copper Company is fixed at £500,000 in £1 shares. The vendors of the property take 400,000 shares as payment for the same; 50,000 shares are to be reserved for future issue; 30,000 shares have been applied for by the directors and their friends; and the general public is now invited to apply for the small balance of 20,000. The vendors are evidently confident that copper has not yet reached its highest point in value, and they will no doubt unload some of their 400,000 shares at a future date. We commend the remarks contained in our "Note" of December 23rd to the attention of any intending applicants for, or purchasers of, these shares.

Pocket-Book.—The Blackman Ventilating Company, Limited, sends us a very neat and convenient little memoranda book. As an additional inducement to continually carry the book in one's pocket, there is a railway accident insurance coupon presented with it for £500, available until December 31st, 1899.

Power-Saving Appliances.—We have received from Messrs. Graham, Morton & Co., Ltd., of Leeds, a catalogue of various classes of machinery for handling coal, grain, &c., of link belting, elevator buckets, coke ovens, millwright work, screens, aerial ropeways, crushers, and other machinery. We think engineers will find it a handy book to have by them. Many of the appliances contained are of a class that are not much known, and we have met those who have frequently needed to make inquiries as to makers of some of the articles we here find.

Rail Bonds.—Messrs. W. F. Dennis & Co. (agents for Felten & Guilleaume) have issued a new illustrated list of the "Neptune" copper rail bonds, and Sellon's patent screw bonds. The same list also describes the "Neptune" flat copper rail bonds, which were supplied for the Glasgow (Springburn) electric trolley trams to the Corporation engineers' own design. The illustration of this method shows triple bonds fixed on the bottom of the rail. The Sellon bond screws in the web of the rail, and we understand is new to the public.

Russell v. Torromé.—We are indebted for the following brief report of the above action to Messrs. Swann & Co., solicitors for the plaintiffs:—This action was brought by Mr. J. A. Russell (trading as Russell & Russell), of 49, Victoria Street, S.W., electrical engineers, against Franco Torromé, of 4, Jeffreys Square, St. Mary Axe, E.C., to recover £143 4s. 2d., the balance of his accounts amounting to £294 6s. 2d. for electric light installation and fittings at defendant's new residence, Hillwood, Lower Sydenham. The defendant, by his defence, alleged that plaintiff had not carried out the work according to his agreement, and part thereof was useless and dangerous, that fittings were charged at excessive prices and not of the agreed description, and in the alternative, while denying all liability, the defendant paid into Court £75. The defendant, by his counterclaim, repeated certain paragraphs of his defence, and alleged that he had by reason thereof suffered damage and claimed £45. The action was tried before Mr. Justice Hawkins and a special jury of the County of Middlesex, on May 10th, 1898, and by consent the jury were discharged, and the action was, on May 11th, 1898, by consent, referred to Lord Robert Cecil, Barrister-at-Law (the arbitrator nominated by the Judge, the parties being unable to agree on an arbitrator) to report. The reference was proceeded with before Lord Robert Cecil on November 10th, 11th, and 17th, 1898, and on December 23rd the arbitrator made his report, which found that the work was done in a first-class manner, and that the goods supplied were in accordance with the estimate and specification, except that some of the switches were slow-break switches, that the work (except as to the said switches) was done according to the rules of the local supply company; that the insulation resistance of the wiring and switches measured four megohms, which he considered was a highly satisfactory result; that (except as to the said switches) the charges for fittings were not excessive; and that the fittings were of the agreed description. The arbitrator reported that plaintiff was entitled to £132 9s. 2d. in respect of the balance of his accounts, and that the sum of £75 paid into Court by defendant was not sufficient to satisfy the plaintiff's claim; also that defendant was entitled to £5 on his counterclaim in respect of the expense occasioned by the slow-break switches supplied. On December 19th, 1898, plaintiff moved before Mr. Justice Hawkins for judgment, and on December 29th, 1898, the judge gave his reserved judgment, and directed judgment to be entered for the plaintiff for £127 9s. 2d. (being the balance of £132 9s. 2d., after deducting the £5 to which the defendant was entitled on his counterclaim) and ordered that the £75 paid into Court by defendant should be paid out to plaintiff in part satisfaction. The Judge gave the plaintiff all the costs of the litigation except costs of counterclaim necessary for recovery of the £5 which were allowed to defendant.

The St. James's and Pall Mall Electric Light Company, Limited.—This company have lodged a Bill for next session for power to acquire additional lands for the erection of further generating and transforming stations. The preamble states that these powers are required to enable the company to meet the increasing demand for electricity within their area of supply, which has largely increased and is increasing.

The Smoke Nuisance.—On Thursday last week, at the Southwark Police Court, the City of London Electric Lighting Company, Limited, of Great Winchester Street, were summoned by the St. Saviour's District Board of Works for allowing black smoke to issue from chimneys at their premises, Meredith's Wharf, Bankside. There were, says the *City Press*, eight summonses in respect to offences on eight days in December. Mr. Pasmore, who defended, applied for an adjournment for two months. On December 8th, he said, the defendants were fined for the same offence, and they were now doing their utmost to abate the nuisance. Their work had increased to a tremendous extent, and as early as last March they entered into a

contract for five new boilers, in order to meet the demand for electric light. Those had been supplied, but some steam pipes were still lacking. When they were fixed there would be an end to all nuisance. Mr. Topham, who appeared for the District Board, objected to an adjournment, and said the defendants had been before the Court half-a-dozen times in the last six or seven years. Defendants were not using smokeless coal. Sanitary Inspector Grist, Inspector Cook, and other witnesses gave evidence of the existence of black smoke. Mr. Pasmore said the defendants were in a difficult position. They had 33 boilers of 600 horse-power each, and two shafts, and alterations could only be made slowly, because they could not stop the supply of electric light. They had spent £8,250 in fitting up automatic stokers, and were doing everything possible to avoid a repetition of the nuisance. Mr. Slade imposed a fine of £5, and 2s. costs, on each summons.

1898.—Messrs. E. P. Allam & Co., who report a busy year, have carried out during that period 147 installations, including several west-end and suburban private houses, and a large number of offices, shops and public houses. Among the contracts in hand at present is the lighting of Messrs. Lion & Son's boot factory with nearly 400 lamps.

Messrs. W. O. Rooper & Robins, of Stafford, also report a very busy year, and send a list of a number of installations erected and now erecting, which include arc and incandescent lighting and power distribution for the Scottish Cyanide Company's Works at Leven, N.B. (Prof. Kennedy, consulting engineer). The lighting of the Shire Hall, Stafford, for the County Council; also of the Town Hall, Chester. The lighting of the Hull Dock offices for the North-Eastern Railway; also of the Hull Dock engine room; of Downswood House, and the Deanery at Chester, the Chester Rows, the temporary lighting of Chester Cathedral, and accumulators and electric motors at Stockton Cement Works for Chas. Nelson & Co., Limited; the re-wiring of the State apartments, Eaton Hall, and the provision of a 2,200 ampere-hour battery for the Duke of Westminster, and the lighting of the Palace, Chester. The overhauling the plant at Peckforton Castle for the Lord Tollemache is in the list, and there are various plants, &c., for country mansion lighting.

ELECTRIC LIGHTING NOTES.

Airdrie.—The Lighting Committee visited the Scottish House-to-House Electricity Company's works at Coatbridge some days ago, and inspected three specimen electric light lamps which that company suggests as suitable for the electric lighting of Airdrie. The town clerk was instructed to ask the electricity company to submit in complete form the scroll of an agreement showing the terms on which they will light the principal streets of the burgh in the event of the Council resolving not to do it themselves.

Aldershot.—The Council last week discussed the Electric Lighting Committee's recommendation to undertake an £11,000 electric lighting scheme, and adjourned further consideration until next month.

Barmouth.—A deputation from the Barmouth Urban District Council has just waited, with the surveyor, upon the Aberystwyth Town Council Lighting Committee for the purposes of acquiring information on the question of electric lighting, which it is proposed to instal at Barmouth.

Barnet.—The District Council last week adopted a draft agreement with the Electrical Power Distribution Company for the lighting of the town.

Bath.—Among the various electrical matters which came before the Electric Lighting Committee last week was a suggestion that all the streets should be lighted by electricity. In the course of the discussion on the point it was stated that whereas to light 600 gas lamps cost about £2,000 a year, 80 arc lamps involved an outlay of £3,000. The matter was ultimately referred to the Works Committee.

Belfast.—The electrical engineer a few weeks ago reported to the Electric Committee that he had made tests on 420-kilowatt steam dynamos at Runcorn, erected by Messrs. Mather & Platt, also on some traction steam dynamos of a smaller capacity at Blackpool and Fleetwood electric traction station erected by the same firm; the results were satisfactory, and he recommended that the tender, being the lowest, be accepted. The Committee recommended the Council "That the tender of Messrs. Mather & Platt for four 400-kilowatt steam dynamos, at £14,500, be accepted." It also recommended that the salary of Mr. V. A. H. M'Cowen, engineer, be increased by £100 a year, making £400, and that of Mr. M. C. Olsen, assistant engineer, by £50 a year, making £200.

Birmingham.—An electric light installation has just been inaugurated at the Queen's Hospital. The installation, consisting of 350 16-candle incandescent lights, has been provided by Veritys, Limited, to the specification of Messrs. Henry Lea & Son. For the service of the hospital the Electric Supply Company have carried a main from the Five Ways to the bottom of Easy Row. The detached ward and the Nurses' Home are included in the lighting scheme, being connected with the service of the main building by underground Callender cables, similar to those used in the streets. All the medical and surgical officers' rooms, the theatre, the chapel, and the administrative departments are fitted with the electric light. For the operating table a special reflector lamp is provided. In the oculists' room a small search light, an illuminated laryngoscope, and other testing appliances, suggested by Mr. Priestley Smith, have been supplied. For the electric cautery, surgical search light laryngoscope, and other portable appliances now used in hospital practice of electricity, switchboards, with transformers, have been placed in convenient positions in each ward, so that the apparatus can be brought to any bed without the use of accumulator or other batteries.

Brighton.—At the last meeting of the Town Council the Lighting Committee submitted a report from Mr. Arthur Wright, electrical engineer, stating that in order to improve the distribution of electrical pressure, and render the light more steady in the districts shown on an accompanying map, it was necessary to contemplate in the near future supplying all consumers in these districts at 230 volts on the three-wire system, and he recommended that arrangements should be at once commenced to enable this change in the supply to be effected within the next 18 months. It was resolved that the recommendations contained in the report be approved and acted upon. The town clerk reported to the Committee, with reference to the loan for £56,300 recently sanctioned by the Local Government Board for the purposes of the electric lighting undertaking of the Corporation, that the Board had only allowed a period of 12 years for the repayment thereof, instead of 25 years, the period for which the Council applied. The Board had allowed 25 years for the repayment of all previous loans for buildings, machinery, &c., with the exception of the loan of £43,300, sanctioned in 1897, for the repayment of which a period of 21 years was allowed. The town clerk did not know the Board's reason for limiting the time for repayment to so short a term, but the result to the Corporation would be that the annual charge upon the electric lighting income would be £5,774, instead of £3,337 (the annual sum necessary to pay off the loan in 25 years) being an increase of £2,437 per annum. It was resolved by the Committee that the town clerk should communicate with the Local Government Board, requesting them to extend the time for the repayment of the loan to 25 years. Councillor Dutton Briant, in moving the adoption of the report, said the Local Government Board was attempting to impose upon them as a Corporation conditions which, if they became general, would simply crush the life out of all municipal undertakings and play into the hands of companies by handing over to them veritable mines of wealth. In Brighton they had sought to make the charges for the electric light as low as possible, consistently with their duty to the ratepayers, with the result that they were 22 per cent. lower than Sheffield, where fuel was so much cheaper. In London 42 years were being granted for the repayment of loans for similar purposes to that for which in Brighton they were only to be allowed 12 years. After a discussion the report was adopted.

Canterbury.—Last week the Town Council confirmed the recommendation of the Lighting Committee that Mr. N. Staniland be appointed electrical engineer at a salary of £200 a year. The report submitted to the meeting by Mr. Hammond showed that in addition to this £200 the salaries of the remainder of the staff would amount to £670.

Cardiff.—At last week's meeting of the Electric Lighting Committee the question of the condition of the cables and the defects in the street lighting was considered. Attention was called to the report that on one day the lights were out from midnight to 5 a.m. The chairman said the people in the town were anxious to know the reason of these failures, and he should like to know if the cables were defective. Mr. Applebee (electrical engineer) said so far as he knew the cables were in perfect condition. The chairman said that would be reassuring to the public, many of whom had the idea that the cables were not so good as they should be. Mr. Applebee said he had every confidence in the cables. He reported them defective about a year ago, and was ordered to replace them. The whole of the cables for the arc, or rectified, lamps had been renewed during 1898, and were perfect. The Chairman: But the light is not perfect, and therefore there is something wrong elsewhere. Mr. W. Evans: Doesn't the continuous rain affect the cables? Mr. Applebee said damp always affected cables, but they had now absolutely the best in the market. The wire was covered with paper and then lead, and they had got a continuous lead pipe over the cable all the way, except where the services were laid to the lamps. As long as the cables were supplying the lamps they could take it there was no damp on it. He had no suspicion of damp affecting these cables at all. Whenever the light went out it was due to the engine, the rectifier, or the lamps. He was confident that the current to the rectified arc lamps was better than ever it was. Mr. Applebee continued: I say the whole problem is the burning of the lamp. The present state of street lighting is deplorable, and it annoys me to see it. I have done my best with the material at my disposal. The Chairman: Yes, but we want to find out the difficulties. Mr. Good said first the transformers were said to be defective, and they were altered. Then the cables were bad, and they were changed. Now it was the lamps, and that meant further expense. Would it be possible to give a steady light for the expense? The Chairman: We can't say anything yet. Mr. Applebee has tried to improve the system ever since he has been with us. He says the wires and cables are all right, but the clockwork in connection with the old lamps is defective, and he is asking to put up two experimental lamps. Mr. Good: The public put the responsibility on us. The Chairman: Of course we accept it, but until we have come to a definite decision on

the lamps that are being tested we cannot do anything else. The committee decided that Mr. Applebee should submit designs of electric pillars and lamps before proceeding with the lighting of Newport Road or any other district.

Chorley.—A sub-committee was appointed by the Town Council recently to obtain information as to the best means of carrying out the electric lighting order, and report.

Coalville.—The District Council will oppose the Bill to be promoted in Parliament by the Leicestershire and Warwickshire Electric Supply Company.

Coatbridge.—A committee of the Old Monkland School Board has recommended that nothing should be done *re* electric lighting during the present financial year, but that the expediency of laying down an installation of their own should be considered before the end of the financial year, and that if it does not exceed the estimated cost, that it be gone on with.

Colchester.—The Military Hospital is now being supplied from the central station in Osborne Street, and the temporary plant will shortly be removed. The total number of lights at the hospital is nearly 500. In the town 50 applications have been received for a total of 2,523 8-C.P. lamps, and of these 28 consumers have been connected.

The Colonial Office.—It is stated that among various alterations being made at the Colonial Office is a general installation of electric lighting for the Great Hall. Hitherto electricity has been in partial use only.

Crewe.—Last week a Local Government Board inquiry was held into the application of the Corporation to borrow £26,000 for electric lighting purposes. Mr. B. Hopkinson said he thought the site was extremely good and central. They proposed to erect a generating station covering about 8,000 square feet, the power to be supplied by two large engines and two small ones. The estimated expenditure in the limited area proposed to be covered was £24,198.

Datchet.—The Datchet Parish Council have passed a resolution approving of the electric light being introduced into the district, and are prepared to support the Slough and Datchet Electric Light Company in their application for powers.

Derby.—At a special meeting of the Town Council on January 4th, the Electric Lighting Committee reported that they had under consideration a report from the recently appointed engineer, Mr. T. P. Wilmshurst, as to the extension of the electric light buildings and plant necessary for meeting the increasing demand for current, and they were of opinion that the present station and land adjoining could be used for this purpose and for future extensions, without a new site being provided for the tramway generating plant. A plan had been prepared by the electrical engineer. The estimated cost of the proposed works, which included structural alterations and additions to the buildings, new boilers, superheaters, and softeners, pumps and steam piping, engines, dynamos, mains, condensers, transformers, and meters was £25,000. This amount the committee were informed would provide the necessary buildings, works, and the plant for the next few years. The estimate included the provision of buildings for the generating plant in case the tramways were worked by electricity, but not any item of the electric plant necessary for that purpose. The Council was recommended to grant the sum of £25,000 for the above purposes, and to direct application to the Local Government Board for sanction to the borrowing thereof. After a brief discussion the recommendations were adopted.

Dublin.—The Corporation has accepted a tender for a new transformer sub-station. £50 has been voted to Mr. Ruddle, the electrical engineer, as a bonus for extra work in connection with the recent failures of the electric cables. Application is to be made to the Local Government Board for a supplementary loan of £7,000 for electrical mains and cables, &c.

Dukinfield.—The District Council will oppose the South Cheshire Electricity Bill and the Lancashire Electric Power Company's Bill.

Ealing.—The District Council last week adopted a report of the Electric Lighting Committee, which stated that the electrical engineer had reported that a main had been damaged, and after very careful investigation he had formed the opinion that the damage had been wilfully done by some person who, after discovering the whereabouts of the main, had very severely dinted the same in several places, necessitating the cutting out of some 35 yards of cable and the laying and jointing of new cable in place thereof. The Committee, fully realising the possible serious consequences of wilful damage of this kind, which might result in serious loss of life and property, recommended that a reward of £50 be offered for information which would lead to the conviction of anyone who tampered with the mains, and that the clerk be instructed to draw up notice to this effect. The engineer further reported that he had discharged seven of the outside workmen through neglect of their work. The Committee having heard the facts of the case, fully endorsed the engineer's action in the matter. Since the previous meeting of the Committee, applications had been received for 191 8-C.P. lamps to be connected, making a total number of 21,538 8-C.P. lamps applied for; of this number 20,414 had been connected. In the course of a short discussion on the subject, the surveyor said it was a diabolical thing that one of the mains should have been tampered with. Whoever did it must have protected himself, or he would have been killed on the spot.

Failsworth.—The Failsworth District Council have received notice from the town clerk of Manchester of the Manchester Corporation's intention of promoting a Bill for the tramways. A copy of the Bill was also received. The clerk submitted a circular and map from the Lancashire Electric Power Company at the last meeting of the District Council, with reference to the formation of the company for the purposes of establishing generating stations and supplying electricity throughout the area pointed out on the map. Failsworth was covered on the map, and so was Oldham. The solicitor to the Council wrote stating that the Council should decide whether they would oppose it or not. They might ascertain before it was necessary to do anything what other local authorities were doing in regard to the matter. A deputation was appointed to attend, if necessary, any meeting that might be called by any authority with respect to the matter.

A similar communication and map were received by the Royton District Council from the Lancashire Electric Power Company, and the Council decided to refer the matter to the Tramways Committee for consideration.

Garston.—Last week at a meeting of the Urban District Council the legal adviser submitted a report on the Special Purposes Committee's recommendation that the Council enter into an agreement with the British Insulated Wire Company, Limited, for the transfer of the rights and obligations of the Council under the Garston Electric Lighting Order, 1897, for a period of 42 years, subject to certain conditions and the approval of the Board of Trade. The conditions stated that the company undertook to have electric light and refuse-destructor works erected within a period of nine months from the date of the transfer, to supply electricity to private consumers at 5d. per unit, and to public lamps at 3d. per unit; to destroy ashpit refuse at 9d. per ton, the company to pay to the Council all the costs of obtaining the order not exceeding £500. The chairman, in proposing the adoption of the recommendation, said he thought the terms were very satisfactory. Captain Turner seconded. After some discussion the meeting was adjourned.

Gateshead.—The Electrical Power Distribution Company has deposited its draft provisional order with the Parliamentary Committee. An agreement is to be sealed between the Corporation and the company, and a committee has been appointed to see that the agreement is properly carried out.

Great Yarmouth.—At the monthly meeting of the Town Council on Tuesday, a report as to the electric lighting undertaking showed that the income for the last three months amounted to £1,697 15s. 2d., and expenditure to £758 0s. 5d. There had thus been earned, beyond cost of production, £939 14s. 9d. Deducting cost of repayment of capital, interest, rates, insurances, and sundries, there remained a clear profit of £369 14s. 9d. on the quarter's working.

Greenwich.—The Board of Trade has asked the Greenwich District Board what observations it has to make in regard to a draft amended form of consent to an extra high pressure supply being given by the London Electric Supply Corporation, together with an amended description of the system to be adopted by that company for the supply of energy under their orders of 1889 and 1896. The District Board has referred the matter to the Parish Committees. The local authorities have been conferring as to the course to be adopted with reference to the proposed provisional order of the County of London and Brush Provincial Electric Light Company, Limited.

Hammersmith.—The Vestry is making application to the City Council for a £56,000 loan, for further extensions of electricity—plant, mains, buildings, &c.

Hampstead.—At its last meeting the Vestry had an important point under discussion. It appears that Messrs. Allingham and Fennell, of Harrow Green, Leytonstone Road, N.E., had inadvertently connected two consumers in Hampstead on to the mains of the Vestry without giving due notice to the Department. For this offence the Electric Lighting Committee recommended that the firm in question and their two delinquent clients should be prosecuted for failing to comply with the rules and regulations of the Vestry. Before the discussion on this recommendation had proceeded far, the vestry clerk, Mr. A. P. Johnson, announced that he had received a communication from Messrs. Allingham & Fennell explaining the circumstances, and stating that they would be very careful that nothing of the kind should occur in the future. One of the consumers had, too, expressed his regret at the occurrence and offered to pay a reasonable amount for the current consumed during the time the unauthorised connection existed. Under these circumstances the Vestry referred the recommendations back to the Committee with power to act.

Harbour Lighting.—The Clyde Trust last week passed the following resolutions *re* electric lighting for the harbour:—(1) That electric lighting be forthwith introduced. (2) That the light be limited at first to the large open spaces where night work is conducted, viz.:—On the north side of the harbour at the Mineral Quay and entrance, Queen's Dock; and on the south side of the harbour at the east end and southmost quay of Prince's Dock, Mavisbank, General Terminus, and Springfield Quays, and Kingston Dock entrance. (3) That the trustees arrange to purchase the current required for the north side; and that the current for the south side be provided by an installation to be formed by the trustees in the engine house, Prince's Dock. (4) That the necessary equipment of lamps, &c., for those localities, and the laying down of the installation, be proceeded with by contract.

Hereford.—Last week the Town Council adopted the report of the Electric Lighting Committee who have been collecting information *re* electric lighting for the town. They reported having prepared specifications and estimates and submitted them to leading firms of manufacturers of the requisite machinery and plant, with the result that they have had tenders from no less than 17 eminent firms, some of whom have tendered for part only of the work, and some practically for the entire work. The committee have selected four of these tenders, and from a comparison, they advise the Council that the cost of the whole of the machinery and plant, including all the expense of installation and of laying the cable, other than the expense of such work as will be performed by the Council itself, will be approximately £12,000. Adding to this £1,000 for meters and connections, £2,000 for the cost of the site and laying it out, £4,000 for buildings and trenches, which the committee propose that the Council's own workmen shall undertake, and £1,000 for legal charges, contingencies, &c., a total of £20,000 is arrived at, and the committee advise that an application should at once be made to the Local Government Board for leave to borrow this sum. The committee are agreed that the form of power should be steam, though they have not finally decided on the type of engine, and they are also satisfied that a low tension three-wire system is the one best adapted for their purpose. "They intend, however, assuming this report is adopted by the Council, to consider still further the tenders above referred to, and to obtain such further advice and particulars as they may find necessary, and they hope both to report further to the Council shortly and to be prepared with a definite scheme by the time the necessary inquiry in connection with the loan to be asked for is held."

Huddersfield.—There was a brief failure of the electric light in some portions of the borough on Saturday night.

Hyde.—An extensive scheme is being prepared for lighting the town with electricity. It will be submitted to the Council in due course.

Hythe.—Owing to an oversight on the part of their staff, the Council's Parliamentary agents omitted to deposit the necessary documents for the electric lighting order. They have returned the £50 deposited, and will remedy the matter when the time again comes round for making application. Some Councillors are rather joyful, because the delay will enable them to judge better of the success or otherwise of electric lighting in other towns.

Ilfracombe.—The surveyor last week submitted to the Council an exhaustive report dealing with the electric lighting of the town. He recommended that the Council carry out the work. The matter is to be thoroughly discussed in committee, as it had been decided to call in the services of an expert electrician. A draft agreement as to the electric lighting of the town was received from the gas company, and deferred for further consideration.

Islington.—At the last Vestry meeting a letter was submitted from the Vestry of St. Pancras with regard to the supply of electric current to the premises of consumers situate on the border line of Islington and St. Pancras. The Vestry had been in communication with the Board of Trade, who stated that they had no power to order the erection of overhead wires. A proposal to appoint a joint committee to confer with their committee on the subject, has been referred to the Lighting Committee for report.

Kilmarnock.—The Town Council has resolved to make application to the Board of Trade for electric lighting powers.

Leamington.—The Town Council has refused consent to the formal application of the Midland Electric Light Company for consent to the application for a provisional order.

Leatherhead.—The Urban Council has now decided to engage Messrs. Handcock & Dykes to advise *re* an electric lighting scheme. A special Council meeting will go into the whole question.

Leeds.—In addressing the Council last week, Alderman Wigram moved the acceptance of the tenders mentioned in our "Contracts Closed." He remarked that this was the first opportunity there had been of giving the Council an estimate regarding the future of the electric lighting undertaking. At the best it would be a mere estimate he should give. The Committee considered that the best course to pursue was to develop the undertaking rapidly but carefully. The items contained in the resolution represented an expenditure of nearly £44,000. The extensions (part of which he had mentioned) were confined to the full development of the existing site, and he believed it would be necessary to expend from £82,000 to £85,000 on the site and on the mains and distributing stations. This would entail, for sinking fund and depreciation, a further charge of £5,000. Without depreciation it would be £3,060. That expenditure would be partly reproductive. He did not think that the whole of those works could be carried out before January 1st, 1901, and the total charge for them would be, with depreciation, about £27,000. and without depreciation, £19,500. The extensions necessary to complete the existing station to its full capacity were:—One 1,000-H.P. engine, on order, £6,350; two 1,000-H.P. engines, £12,150; five boilers, with pipes and setting, £9,500; seven sub-stations, £16,400; and the Hunslet extension, £8,400. These matters had not been put out for competition. The Committee had thought it wise to complete the station on the plans, and as nearly as possible on the lines laid down by the company. They had done so because it was very difficult in a great business like this to avoid wasting time. The growth and demand for electricity was very rapid, and the engineer advised that it was most important that the work should be pushed on. That being so, the Committee had dispensed with any application for contracts. There was a further proposition to extend the cables and lighting power to Hunslet, and perhaps the reason Hunslet was chosen was because there was a hope of getting an exceedingly good customer for a large sum of money in that direction. If that customer was secured, no doubt the Hunslet extension would immediately pay. The cost of coal conveyers, tank, inclined draught, and switchboard extension amounted to £3,400. To carry and distribute the current, which they would then be able to generate, additional mains and sub-stations would be required, and this would mean an outlay of £25,000, bringing the total up to £82,000. This would enable the Corporation to develop the existing station to the maximum. It, however, took no account of the Britannia Mill site, and the Committee would therefore have to come before the Council again for money necessary to be expended there. The existing station allowed of an output of 2,400 kilowatts; the engine on order would give 600 kilowatts, and with the proposal for 1,200 more there would be a total of 4,200 kilowatts. In 1897 the existing station earned £13,054 net. The units sold increased from 833,000 in 1897 to 1,199,000 in 1898, an increase of 43 per cent.

The Lighting Committee asked the Council to sanction the expenditure of £14,296 upon further mains and accessories. At present the mains only supply the centre of the city, Chapeltown, and Headingley. The Lighting Committee want to carry the current to Hunslet, where it is anticipated it will be utilised for illuminating many of the big engineering works in that locality. Further extensions in other parts of the city are also in contemplation, though they have not yet been definitely decided upon.

Lynn.—The Public Works Loan Commissioners have decided to advance the Corporation £27,000 for the purposes of electric lighting, repayable in 25 years, and £1,000 for the purpose of wiring the Town Hall and other municipal buildings, to be repayable in 10 years, the interest to be 2¾ per cent. and 2 per cent. respectively.

Malvern.—The Board of Trade has agreed to defer for a year the question of revoking the electric lighting order granted to the Council in 1890. If at the end of the year no steps have been taken, the order will be cancelled.

Middlesbrough.—The question of a site for electricity works is occupying the attention of a sub-committee.

Mile End.—The Guardians are asking the opinion of an expert from the Phœnix Insurance Company *re* the electric lighting arrangements at the infirmary. A member declares that it is not working properly.

Mumbles.—Mr. N. Weaver (of Messrs. Weaver & Co.) has at his private residence at Mumbles an electric light installation, and he has offered to supply current for the lighting of the village. The offer has just been considered by the District Council, who have resolved before determining upon the offer to invite tenders for the lease of their electric lighting order.

Newcastle.—Messrs. Wood, Skinner & Co., shipbuilders, Bill Quay, near Newcastle, have just had a complete electric light installation put down for lighting the whole of their premises, including works and offices. This work has been carried out by Mr. E. J. Jennings, A.M Inst.E.E., and the plant fitted comprises a No. 7 Brush dynamo, capable of maintaining 16 2,000-C.P. arc lamps, or 128 16-C.P. incandescent lamps, the dynamo being driven by a Clench's vertical high speed engine. The fittings erected comprise 13 arc and 48 16-C.P. incandescent lamps with all accessories. The electric light installation will allow the firm when necessary to work a continuous night and day shift.

Newport.—At a recent meeting of the Electrical Committee the office manager's report for the month was read, from which it appeared that the orders for new connections were equivalent to 556 8-C.P. lamps, bring the total connected and on order up to 22,271 8-C.P. lamps. The borough electrical engineer submitted his report upon the condition of the plant and machinery, which was considered satisfactory. The emergency plant is now being run on the load. The report gave a comparison of the capacity of the plant with the number of lights connected, showing that the plant is now slightly underloaded. With reference to the abatement of the smoke nuisance, the electrical engineer reported that Messrs. Newtons had made various experiments with their apparatus which had been affixed to No. 2 boiler, with the result that the smoke is undoubtedly lessened, but the grate area has been reduced. The electrical engineer suggested that a report should be made upon the boiler by the insurance company. It was resolved that he be instructed to have this done. The consulting electrical engineer, Mr. Hammond, who was in attendance, submitted a report upon the progress and present position of the various contracts, and was requested to urge the contractors generally to complete as soon as possible. With reference to the threatened action of Mr. Stephen Taylor as to the alleged damage to his property in Llanarth Street, caused by the proximity of the electric lighting station, the borough engineer reported that he had visited the premises of Mr. Taylor, and submitted a report upon the result of his visit. It was resolved that the town clerk be instructed to take all necessary steps for defending any actions, whether for an injunction or damages, which may be brought.

Oswestry.—It is stated that arrangements have been made for the electric lighting company to shortly put up, in and about the Cross, four 1,000-C.P. arc lamps. They will supply the current free of charge for a month.

Oystermouth.—The Local Board last week decided to advertise for tenders for the electric lighting of the whole of the district.

Paignton.—Messrs. Handcock & Dykes recently wrote offering to advise the District Council *re* electric lighting. This led to a general discussion on the question at last week's Council meeting, but in the end the matter was left in abeyance.

Pontefract.—The Guardians on Saturday instructed the Building Committee to inquire into the question of installing electric light in the workhouse.

Pontypool (Mon.).—The Council are contemplating lighting their central streets with electric arc lamps. At the last meeting a price for the lighting of such streets was submitted by the Electric Light Company of the town, a committee of the Council being appointed to confer with them on the question. Since the company was formed a few years ago rapid progress has been made, and quite recently they have been engaged in making an important extension of their system.

Poplar.—The District Board have accepted the Electric Lighting Committee's scheme for lighting the district by electricity at a cost of £79,000.

Plymouth.—It has been decided that the control of the public lighting of Plymouth shall be transferred on March 31st from the gas company to the Corporation. From that date Mr. J. H. Rider, the electrical engineer, will have charge of the arrangements, and as the electric light should then be available for the principal streets, he will be able to show the people of Plymouth for the first time what well-lighted streets really are. As the electricity works are approaching completion, the Electric Lighting Committee have again considered the question of charges for current. Eighteen months ago they expressed an opinion in favour of the Brighton system, and fixed a provisional scale of 8d. per unit for current supplied to lamps burning one hour or less per day, and 3d. per unit where the supply is over one hour per day. They have now revoked this and decided to make a uniform charge of 4½d. per unit to private consumers whether the quantity be large or small, or the use for lighting or power.

Redcar.—For a proposal to appoint a committee to consider the electric lighting question there voted 4 in favour and 4 against. The chairman of the Council would not exercise his casting vote.

Rugby.—The District Council last week considered the scheme of the Leicestershire and Warwickshire Electric Supply Company, and decided to oppose the Bill at a cost not exceeding £10.

Salford.—At last week's Council meeting, in the course of some questions on the minutes of the Electricity Committee, Mr. A. Haworth, the chairman of the committee, warmly protested against the undercurrent of opposition to everything the committee did. The committee, he said, took over practically a bankrupt concern, and had made good progress with their work, but they were always being met with captious criticism. They would have no alternative but to resign unless they were treated more fairly. Mr. Alderman Snape protested against the tone of Mr. Haworth's remarks. It was most important, he said, that in dealing with a proposal to spend £250,000 of the ratepayers' money, questions should be asked and criticism offered, and Mr. Haworth ought not to take offence where none was intended.

Last week a committee recommended the Council to petition against the Lancashire Electric Power Company's Bill, and against the Manchester Corporation Tramway Bill, which gives the Corporation power to make agreements with Eccles and Swinton. The Council was also recommended to approve of the appointment of Messrs. Lacey, Clirehugh & Sillar, as consulting engineers in connection with the plans and specifications for the proposed machinery and plant required for the electrical undertaking in the borough for a term of three years, at a sum of £500 per annum.

Sheffield.—It is stated that about 6 o'clock on Monday evening there was a failure in the supply for about half an hour. It is said that there was something wrong with the machinery.

South Shields.—At last week's Town Council meeting Alderman Rennoldson, in moving the adoption of the Electric Lighting Committee's report, stated that the end of the quarter showed a very satisfactory state of things. The number of units consumed was 79,000, as compared with 33,000 units for the same quarter of the previous year. The amount had exceeded their estimate by 4,000 units, which meant an increase in the revenue for the quarter of something like £60.

Stretford.—At the last meeting of the Urban District Council, Mr. Wardale moved the resolutions passed at a former meeting relating to the electrical supply scheme, and this was met by a counter resolution by Mr. Slyman that they be not rescinded until after a poll of the ratepayers had been taken. Mr. Wardale pointed out that there was no sign of an intention to take a poll. They were going to approach the Manchester Corporation, and could not well do so with those resolutions on the books. The chairman thought feeling regarding the question was undergoing a change, and he wished the ratepayers to have sufficient time to see their way clear on the matter. It was ultimately decided to adjourn the consideration of Mr. Wardale's resolution for three months. A letter was read from the Local Government Board stating that they knew of no statutory authority under which the Council would be empowered to incur expenditure for the purpose of taking a poll of the inhabitants of the district on this question. The Public Health Act and the Electric Lighting Act contained no provision to meet such a case.

Tunbridge Wells.—Owing to the rapid progress and success of the electricity undertaking in this borough, the Council unanimously decided at their last meeting (January 4th) to apply for another £25,000 loan. The last loan of £15,000, although only sanctioned in November, 1898, has already been spent on extensions. This makes the fourth application in a little less than four years.

Walthamstow.—The District Council has received a letter from the Local Government Board *re* the application for permission to spend £36,490 on electric lighting works, asking for further particulars, and for the estimated revenue. A sub committee has been appointed, with plenary powers to obtain the necessary information.

Warrington.—Mr. A. H. Preece's report on electric lighting, which we abstracted last week, is being considered by the Electric Lighting Committee, and the Council will shortly have a discussion on the matter.

West Hartlepool.—At last week's Council meeting an amended plan of the new electric lighting station, prepared by Prof. Kennedy, was approved. It was stated that the delay in getting the electric lighting scheme under way was entirely due to the difficulty over the building. The work, however, is now in progress.

Weybridge.—After considering a report by a special committee upon the proposed scheme of the Electric Works Company for lighting Weybridge, the Urban Council has decided to oppose the provisional order application.

Wimbledon.—Four candidates have been asked to attend before the Roads and Bridges Committee with reference to the proposed appointment of a resident engineer for the electricity works.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Behr's Lightning Express.—A Liverpool paper says that arrangements had been made for the delivery of an address to the members of the Liverpool Chamber of Commerce and their friends on the subject of a proposed express electric monorail railway by Mr. F. B. Behr, A.M.I.C.E., of London, yesterday afternoon. Mr. Behr claims to have gone minutely into the construction of all the details of the proposed Liverpool-Manchester Lightning Railway, and to have evolved a scheme to ensure the success of such a line.

Dewsbury.—The Town Council has resolved, as recommended by the General Purposes Committee, that opposition should be made to the Spen Valley and Dewsbury scheme of tramways promoted by the British Electric Traction Company. The Council will themselves apply for powers to construct a local tramway.

Dublin.—It is stated that on 6th inst. a guard wire snapped and fell upon a trolley wire and carried the current to the ground with somewhat unhappy results. There was trouble among the horses, &c., until tramway current was cut off and the matter put right. This report is contradicted in later accounts.

Glasgow.—The Town Council last week had before it the following minutes of the Tramway Committee:—"After full consideration, the sub-committee were of opinion that it is desirable that any method of traction which may be adopted in Glasgow should be one which can be applied to the whole tramway undertaking, and that, in addition to the fact that the conduit system is estimated to cost nearly twice as much as the overhead, and other minor considerations, such as the effects of the damp and slush in our wet climate, the difficulty of localising and rectifying faults, and the greater interference with the streets during construction, the available depth of street over the Central Railway, and a considerable number of railway and river bridges (which, in point of fact, affect almost all the tramway routes), practically precludes the adoption of the conduit system for the city. They therefore could not recommend the Corporation to enter upon an experiment of the conduit system at this stage. They were further of opinion that arrangements should be made for proceeding at once to adapt the tramways for the overhead system of electric traction, and that as much progress as practicable should be made before the opening of the exhibition of 1901. If the overhead system were adopted generally, and if in the future some system of electric traction which dispenses with the overhead wires were found to be practicable for the Glasgow tramways, the removal of these wires would not involve any considerable loss, as the permanent way, feeders, and rolling stock would be equally suitable for any system of electric traction. The

committee remitted to that sub-committee to prepare and submit a report as to the best method of adapting the tramways for overhead electric traction, with power to consult an expert should they find it advisable to do so. It was further agreed that the Sub-Committee on Traction and Works should, from time to time, report upon any developments of methods of traction suitable for the city." This was adopted by a large majority.

The Kelvinside Electricity Company has intimated that if the powers sought to supply electricity for tramway purposes in Kelvinside is not withdrawn from the Corporation Tramways Bill they will oppose it. The town clerk replied that the Corporation had already power under their Act of 1891 to use electricity for the Kelvinside tramways.

Liverpool.—Mr. John O'Neill, the Corporation general tramway manager, who has been connected with the Liverpool tramways for 34 years, is shortly to retire on a pension.

Manchester.—At last week's Council meeting, on the minutes of the Tramways Committee being considered, Mr. Johnston asked if the committee had considered the desirableness of immediately providing workshops for the purpose of making their own cars, and employing workpeople here, instead of buying the cars in Germany, America, or elsewhere. Mr. Boyle (chairman of the Tramways Committee) said the committee did not intend to buy the cars in America or Germany or elsewhere if they could get them in England. They had consulted car builders in this country, and he believed they could get cars without going abroad.

Perth (W.A.).—The *Australian Mail* says that Mr. Cook and Mr. Childs, the engineers representing the firm of Messrs. J. G. White & Co., of New York, who have undertaken the construction of the Perth electric tramways, have arrived at Perth, and are very favourably impressed with the prospects of the undertaking. They state that, owing to the heat of the climate, the hilly nature of the city, the badness of the roads, and the large and scattered area within the city boundaries, Perth is a model city for a successful tramway enterprise.

Pontypridd.—The British Electric Traction Company's first scheme for a tramway from Pontypridd to Treherbert has for the present been abandoned.

Portsmouth.—On Wednesday last week, a deputation visited Dover to inspect the electric tramway system. The deputation is stated to have decided to proceed to Rouen and Havre to inspect tramway systems there.

Reigate.—The town Council has resolved, on the recommendation of the Electric Lighting Committee, to apply to the Light Railway Commissioners for powers to put down an electric tramway between Redhill Junction station and the Redcross Inn in Reigate in connection with the electric installation.

Rhondda Valley.—Application is to be made for the transference of the property, rights, and privileges of the old Pontypridd and Rhondda Valleys Tramways Company to the British Electric Traction Company, Limited. The consideration mentioned is £12,000.

Spain.—The General Electric Tramways Company of Spain has, says the *Observer*, been constituted in Brussels, with a share capital of 10,000,000 francs, under the auspices of the Empain financial group, the Banque de Paris et des Pays Bas and the Banque de Bruxelles. The company has acquired the Madrid Eastern Tramways and those of Barcelona and Soria, and negotiations are pending for the acquisition of other lines by the company.

Swansea.—Messrs. J. P. Rowlands & Co., architects, Swansea, have received a commission from the British Electric Traction Company to prepare plans for a large generating station on the site of the present tramway depôt, and also for an elaborate set of offices. The plans are to be out, and tenders in, within the month.

Underground Electric Railways.—The Islington Vestry has received a letter from the Vestry of St. Margaret's and St. John's, Westminster, calling attention to the importance of a combined action being taken by the whole of the District Boards with reference to underground electric railways.

Walsall.—The Tramways Sub-Committee recently reported as to the negotiations which had been pending for nearly three years for the purchase of the tramways undertaking in the borough, and which had failed in consequence of the legal difficulties which existed owing to an agreement between the tramway company and the British Electric Traction Company. The Sub-Committee recommended that, if satisfactory terms can be arranged, the Council should purchase the tramway lines, and grant a lease thereof to a substantial company to work them on terms to be agreed upon. The General Purposes Committee has deferred consideration of the report until an early date.

Warwickshire.—A large light railway scheme is being arranged for a portion of North-East Warwickshire, which will extend over upwards of a dozen miles and open up communication by means of electric cars between Nuneaton, Chilvers Coton, Stockingford, Hart's Hill, Ansley, and other villages.

Wrexham.—The District Council has consented to the application of the Wrexham Tramways, Limited, for a provisional order for the construction of additional and substituted tramways. It is proposed to run the trams from Johnstown to Wrexham, and through the main streets of the town, and they are to be worked on the overhead trolley system.

TELEGRAPH AND TELEPHONE NOTES.

The Australian Cable Service.—A *Financial Times* correspondent draws the attention of the public, and especially of those interested in Australian enterprise, to the very disadvantageous conditions under which the cable service to the Australian colonies is conducted. He publishes several letters which have passed between himself and the Eastern Telegraph Company with reference to certain inaccuracies which have occurred in transmission.

The Pacific Cable.—In an article on "Britain Beyond the Seas—1898," the *Daily News* says:—"To Australasians the Imperial year has been one of disappointment. They have failed to get the Pacific cable. Whether the continued delay is due to any secret influence of the Eastern Telegraph Extension Company, as Australasians think, or to other causes, it is fruitless to speculate. Just at present it seems possible that it may be left to America to lead the way in Pacific cable laying."

A Reuter's telegram fron Ottawa says it is declared that there is no authority for the statement that the Dominion Government had offered to contribute an equal share with the Imperial Government towards the cost of a Pacific cable. The matter is still under consideration of the Cabinet, and no decision whatever has been arrived at.

The Telegraph Wire Export Trade.—Although there was a little more activity during December last in the export trade of this country in telegraph wire and apparatus connected therewith than in the preceding month, yet the month was a very quiet one when compared with the past two years, the shipments only attaining a value of £41,250, as against £172,140 in the corresponding month of 1897 and £118,720 in December, 1896. Turning to the returns for the whole of the past year, these, notwithstanding the falling off in December, are very satisfactory, showing as they do a total of £1,017,808, as compared with £997,802 in 1897 and only £857,174 in 1886.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	June 11th, 1898 ...	...
Para-Maranham	Nov. 14th, 1898 ...	...
Candie-Sitia	... Jan. 5th, 1899	... Jan. 11th, 1899
LANDLINES.		
Majunga-Tananarive	... Jan. 3rd, 1899	... Jan. 4th, 1899
" "	... Jan. 10th, 1899	... Jan. 11th, 1899
Communication with Fao (Between Divanich and Semava) ...	... Dec. 24th, 1898	... Jan. 5th, 1899
SIBERIAN LINES.		
Chabarowka-Blagowestschensk ...	... Jan. 8th, 1899	... Jan. 9th, 1899

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—January 20th. The Corporation is inviting tenders for the wiring of the free library, Cornwallis Street. Plan of building at the office of the Borough Electrical Engineer, Town Hall, and specification from the Town Clerk, Town Hall, on payment of £1 1s., returnable as usual.

Belfast.—February 2nd. Tenders are wanted for cast-iron pipes, frames, and covers, earthenware conduits, cables, and Lancashire boilers. See "Official Notices" this week.

Belgium.—January 25th. Tenders are being invited until the 25th inst. by the Compagnie Générale de Traction, of 6, Rue de Meridien, Brussels, for the supply of 10 tons of galvanised iron wire and 9,000 porcelain insulators. Tenders to be sent to above from whence particulars may be obtained for 1 franc.

Christiania.—February 26th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Christiania, stating that tenders are invited by the Norwegian State Telegraph Administration for the delivery of about 140,400 porcelain telegraph and telephone insulators. Tenders must be received at Christiania by 12 o'clock noon on February 26th, 1899. A copy of the specification, conditions, &c., may be examined on personal application at the Commercial Department of the Foreign Office any day, between the hours of 11 a.m. and 5 p.m.

Ealing.—January 30th. Tenders are invited by the Council for two 500-H.P. steam alternators and one 150-H.P. steam dynamo alternator. See our "Official Notices" this week.

Glasgow.—January 21st. The Corporation invites tenders for generating plant at one or other of their new electricity works:—Two engines each of 200, and two of 400; three of 1,100, and two of 2,200 indicated horse-power, with dynamos and condensing

plant. Specifications, forms of tenders, &c., from Mr. Chamen, city electrical engineer. See our "Official Notices" December 16th, 1898.

Govan. — January 23rd. The Commissioners want tenders for the supply of water-tube boilers, feed heater, engines, dynamos, equalising transformers, boosters and motor pump, cables, accumulators, arc lamps and standards. Specifications from Mr. W. Arnot, 57, West Regent Street, Glasgow. See our "Official Notices" January 6th.

Halifax.—January 24th. Tenders are wanted for the supply of one 600-kw. steam alternator for the Corporation. See our "Official Notices" this week.

London.—January 25th. The Metropolitan Asylums Board want tenders for switchboards, booster and connections, battery, mains, steam piping, also wiring and fittings for the electric lighting of the Northern Hospital, Winchmore Hill, N. See our "Official Notices" this week.

London.—January 31st. The L.C.C. is inviting tenders for four continuous current dynamos, one motor generator, two switchboards and switches, &c., for the proposed Victoria Embankment installation. See "Official Notices" December 30th, 1898.

Lowestoft.—February 6th. The Corporation want tenders for the supply of boilers, steam dynamos and motor boosters, storage batteries, switchboard, travelling crane, mains, arc lamps and posts; and for the lighting of the station. Consulting engineer, Mr. W. C. C. Hawtayne. See our "Official Notices" January 6th.

Roumania.—January 16th. Tenders are being invited until January 16th by the General Direction of the Roumanian Post and Telegraph authorities in Bucharest for the supply of 2,000 small porcelain insulators, 15,000 medium size ditto, and 10,000 large ditto.

Southampton.—January 16th. The Corporation wants tenders for transformers and fittings. See our "Official Notices" January 6th.

Stirling.—January 30th. The Burgh Commissioners want tenders for electric light mains. See our "Official Notices" this week.

Sunderland.—January 27th. The Corporation wants tenders for roadwork, with stoneware casings, and supplying and laying electric light cables. See our "Official Notices" this week.

CLOSED.

Leeds.—The City Council last week authorised the acceptance of the tender of Messrs. Daniel Adamson & Co. for the supply of four boilers, pipes, &c., at £6,278, and four super-heaters at £648, and the tender of Messrs. G. E. Belliss & Co. for two 1,000-H.P. engines at £6,150 and £6,000 respectively; and also authorised the Lighting Committee to carry out extensions of sub-stations at the estimated cost of £16,409, and extensions of mains to the Hunslet district at the estimated cost of £8,408.

Lincoln.—The City Council is ordering further cables from the Callender Cable Company at £1,000.

FORTHCOMING EVENTS.

Friday, January 13th.—At 8 p.m. The Institution of Civil Engineers. Students' Meeting. Dr. Archibald Barr, M.I.C.E. (Professor of Civil Engineering and Mechanics in the University of Glasgow), will deliver an address on "The Application of the Science of Mechanics to Engineering Practice."

Tuesday, January 17th.—At 8 p.m. The Institution of Civil Engineers. "The Effects of Wear upon Steel Rails," by William G. Kirkaldy; "On the Microphotography of Steel Rails," by Sir William C. Roberts-Austen, K.C.B., F.R.S., &c.

Wednesday, January 18th.—At 7.30. Institution of Electrical Engineers. Students' meeting in the library of the Institution. Paper to be read: "The Effect of Governors on the Parallel Running of Steam Alternators," by Leonard Wilson, student.

Friday, January 20th.—At 6.30 p.m. Institute of Marine Engineers Tenth annual conversazione at the Town Hall, Stratford.

Friday, January 27th.—At 5 p.m. Physical Society. Agenda: "On the Equivalent Resistance and Inductance of a Wire to an Oscillatory Discharge," by Edwin H. Barton, D.Sc., F.R.S.E.; Exhibition of (*a*) A Dephlegmator, (*b*) A Temperature Tell-Tale, by R. Appleyard; "On the Volume Changes accompanying Solution," by T. H. Littlewood.

NOTES.

Depreciation of Machinery and Equipment of Street Railways.—One question which comes to the street railway investor and to the general manager is, how long will the power station machinery, the cars and motors and line material last? This, says the *Street Railway Review*, has been carefully estimated for the Chicago City Railway Company by G. W. Knox, electrical engineer, his figures being based on the renewals and per cent. of wear. In some particulars the following table seems to give an unusually long life for certain portions of the equipment which past experience does not warrant. Many companies have reconstructed their roadbeds after five or six years; the two and four-pole generators which were in universal use eight years ago have been replaced by modern machines; there are few cars and trucks 10 years of age still in service. However, the figures are based on life of the present equipment which, from the engines to the rail bonds, is in every particular more substantial and durable than that of five years ago. The table gives the depreciation in per cent. per annum.

	Per cent.		Per cent.
Power Station.			
Engines	8	Generators	3
Boilers	8	Building	5
Cable Machinery.			
Cable Machinery	10	Cables	175*
Roadbed.			
Rails	5·5	Paving, Brick	7
Ties	7	Paving, Asphalt	7
Paving, Granite	5	Paving, Macadam	6
Paving, Cedar Block	16		
Cars.			
Car Bodies	7	Trucks	8
Rolling Stock.			
Armatures	33	Wiring and other electrical Equipment on Cars	8
Fields	12		
Gear Cases	20	Commutators	33
Controllers	4		
Line Equipment.			
Poles, Iron	4	Trolley Wire	5
Poles, Wood	8	Trolley, Insulation	7
Insulation	12	Bonding	8

[* Query.—Should this be 1·75?—Eds. Elec. Rev.]

Personal.—The Electricity Department at West Ham was from the commencement under the Highways and Parks Committee, but it is now to be managed by a new committee, called the Tramways and Electric Lighting Committee. At the last meeting of the old committee a recommendation was made that the salary of Mr. Steinitz, the borough electrical engineer, should be at once increased by £200 per annum. This was carried unanimously by the committee, and subsequently by the Council on Tuesday night. We congratulate Mr. Steinitz.

Forthcoming Lectures.—Mr. James Swinburne commenced a course of lectures upon "Dynamo and Transformer Construction" to the senior students of the Electrical Standardising, Testing, and Training Institution yesterday (Thursday).

Presentation.—On 5th inst. a number of members of the electrical staff of the Dublin United Tramways Company met at the Royal Hibernian Hotel for dinner, after which a gold watch was presented to Mr. J. A. T. Marsh, late chief assistant of the Clontarf electric tramway, who has obtained an appointment in Dudley with Messrs. Wilson & Strong, of London.

Municipal Corporations and the Large Power Schemes.—On Tuesday the Lord Mayor of Manchester presided at the Manchester Town Hall over a large meeting, which, as already announced in the ELECTRICAL REVIEW, was convened to organise the opposition of municipal corporations in Lancashire and Cheshire to the Lancashire Electric Power Bill and the South Lancashire and Cheshire Electric Bill, which will come before Parliament in the coming session. The chairman said that the promoters of the Bills proposed to go through various towns and supply electric power. Those present were representatives of boroughs which were in the same position as Manchester, in that they had obtained powers by Board of Trade order to supply electricity for lighting and motive purposes. Alderman Higginbottom (chairman of the Manchester Corporation Electricity Committee) moved:—"That this conference of municipal corporations of Lancashire and Cheshire within the area comprised in these Bills protests against the same as violating the principle for which municipal corporations have in past years successfully contended, and which have been established by the Tramways Act of 1870 and the Electric Lighting Acts of 1882 and 1888, and determines to take united action in opposition to the Bills." Mr. Petrie (chairman of the Liverpool Electricity Committee) seconded the motion. The motion was supported by the town clerks of Southport and St. Helens, and passed unanimously. Other resolutions were adopted on the motion of the Mayor of Salford and Corporation officials of Wigan, Oldham, Bolton, Blackburn, and Birkenhead.

The London Chamber of Commerce—Electrical Trade Section.—A meeting of the above Section was held at Botolph House, Eastcheap, on Friday last, 6th inst. Among the questions down on the agenda for consideration was: "Municipalisation.—To consider the threatened municipalisation of electrical undertakings, and what action should be taken in reference thereto." After a general discussion, a committee was appointed to enter further into this very important matter, and report. The next matter discussed was that of municipalities and electrical fittings—"To consider the applications now being made by corporations for power to deal in electrical fittings and apparatus, and what action should be taken in reference thereto." A resolution was passed expressing the Section's objection to such transactions, and opposing the principle involved. Among matters which had to be left over was the consideration of the present position of electrical supply companies in London, also a proposal to form a separate Trade Section of this Chamber in the exclusive interests of electrical traction.

Metals and Alloys.—Our contemporary, *Engineering*, of December 30th, gives a very useful table exhibiting the physical and electrical properties of various metals and alloys in a form that is easy for reference. The table includes specific resistance, temperature coefficient, melting point, specific heat, tensile strength, and specific gravity, of about a hundred different materials used in electrical work, besides giving the proportion by weight of the components of the alloys. It has been drawn up by Messrs. Parshall & Hobart from the results of various observers, Dewar and Fleming, Hopkinson, Feussner, Lindeck, and others.

Retirement of Sir Spencer Walpole.—It is announced that Sir Spencer Walpole, Secretary to the Post Office, will retire from that position on 14th prox., he having reached the age of 60, at which he is entitled to claim his pension. Sir Spencer has occupied his present position since November, 1893.

Light Railways v. Tramways.—When the Hanwell-Uxbridge Light Railway inquiry was held recently, the Great Western Railway Company objected to the scheme, and stated that the system was to all intents and purposes a street tramway, intended solely for passenger traffic. It was considered that the scheme was not such as should be promoted under the Light Railways Act. We now understand that the Board of Trade has decided that the line is a light railway within the meaning of the Act. The inquiry will shortly be re-opened.

Alexandra Palace Exhibition, 1899.—This year the Alexandra Palace authorities will hold from April to October a great exhibition of commerce, manufactures, inventions, and art. In the classification of sections open to competition for awards we note that there is one set apart for electricity. All interested in the exhibition may obtain prospectuses on application to Mr. Cecil Barth, general manager.

The Institution of Electrical Engineers.—Last night, after the presentation of premiums, the discussion on the following papers was continued:—"Improvements in the Magnetic Space Telegraphy," by Dr. Oliver Lodge, F.R.S.; "Telegraphy by Magnetic Induction," by S. Evershed; "Aetheric Telegraphy," by W. H. Preece, C.B., F.R.S. In the event of time permitting, papers were to be read as follows:—"Rules for the Regulation of the Wiring of Premises for Connection to Public Supply Mains," by J. Pigg, associate; "The Regulation of Wiring Rules," by C. H. Wordingham, member; "The Institution Wiring Rules," by R. E. Crompton, past-president.

Willans Engine Valve Gear.—Mr. John Svenson read a paper on "The Valve Gear of the Willans Engine" before the American Society of Mechanical Engineers recently. His summary of the various characteristics possessed by this valve gear brings out a very flattering result. Minimum number of parts and simplicity of form and construction; a free inlet and release, and a cut-off so sharp as to rival even a Corliss; a balanced valve of the piston type, with very small clearance spaces, and which by virtue of its position is easily kept steamtight; great facility for varying the cut-off; perfect adaptability to the difficulties of high rotative speed. Such are in brief its leading advantages. I can think of but two shortcomings. One is that the limit of its general adoption in the form here represented is reached in an engine having single-acting cylinders only. The other is the difficulty of arranging it to run reversing. The first objection, and perhaps the second as well, will have but slight effect on its destiny, insomuch as its proper field of action will be confined to the high-speed engine, where single-acting cylinders will in all probability prevail.

James Bowman Lindsay.—At the time of the struggle for "preference" in wireless telegraphy, the newspapers had a great deal to say about the neglected name of James Bowman Lindsay, electrician, astronomer, and linguist. Mr. J. J. Fahie is writing a very laudatory account of this mon o' Carmyllie in the pages of the *Electrical Engineer*, in an article adorned with a portrait, and embroidered with curiously punctuated verse.

Appointments Vacant.—The Canterbury Council wants an assistant electrical engineer, two junior electricians, and others, for the electricity works. The St. Helens Council wants two shift engineers. See our "Official Notices."

Long Distance Telephony.—A New York contemporary says that an extraordinary long-distance telephone test has been made at Little Rock, Arkansas, by President Chas. J. Glidden, of the South-Western Telegraph and Telephone Company, who held a conversation over the wire with a Boston gentleman. The distance from Little Rock is 1,900 miles. Mr. Glidden says that this is the longest circuit in the world and the talking was excellent.

Study of the Electric Arc.—The *Physical Review* for the past few months has contained some interesting accounts of experiments on the arc. Mr. N. H. Brown contributes a paper describing a photographic study of arc phenomena, particularly relating to the alternate-current arc, following on the similar experiments made by Blondel and McMynn. The results are presented in a series of photographs obtained from a rapidly moving plate. Messrs. Merritt & Stewart describe their recent investigation of the electrical properties of the vapours from a carbon arc, especially noting the discharging power of such vapours. In general, it is stated, the electrical properties of the vapours from a carbon arc are similar to those of gases that have been acted on by X rays, or to the gases from an ordinary flame.

The Copper Market.—The last statement issued by Messrs. H. R. Merton & Co., dated December 31st, 1898, will not bring much comfort to those large consumers of copper who may have been hoping that the period of high prices was over. The average price of G.M.Bs. for the fortnight ending December 31st was £57 10s., while the stocks of copper in port and visible supplies, as regards Europe, had increased from 26,904 tons to 27,896 tons. The total supplies for the 12 months have been 230,892 tons, and the total deliveries, 234,951 tons, as against 221,724 tons, and 224,696 tons in 1897. The advance in consumption in 1898 has, therefore, not been very marked, and taken alone it has not justified the extraordinary rise of £9 5s. per ton in the value of refined copper during the past 12 months. This rise is evidently largely due to prospective—not present—requirements. The following figures, showing the chief sources of the European supplies during the years 1897 and 1898 are of interest :—

	1897.	1898.
North America...	130,363	133,303
Spain and Portugal	25,029	23,057
Chili	21,750	24,850
Australia	11,100	15 750
Other countries	33,482	33,932
Totals	221,724	230,892

The greatest increase during the past year has thus occurred in connection with the shipments from Australia, and we anticipate that a still greater increase in the shipments of copper from this quarter of the world will occur during the current year.

Calcium Carbide Regulations.—Strict regulations as to the sale and use of calcium carbide and acetylene in New York have been adopted by the Fire Department. The *Engineer* says that, according to the new rules, all calcium carbide in transit through the city and on storage must be enclosed in hermetically sealed iron receptacles, and plainly marked "Calcium carbide; dangerous if not kept dry." No single package must exceed 100 lbs. As to the sale of the carbide, not more than 20 lbs. either in bulk or in cartridges can be stored or kept in any building used for dwelling or mercantile purposes, and this amount can be only kept on a permit obtained from the Fire Department. This permit will provide that all quantities in excess of 2 lbs. shall be in tight metal packages, and be kept elevated at least 6 inches from the floor, in a fire-proof safe located above the street grade. The manufacture, transportation, storage, sale, or use of liquefied acetylene is absolutely prohibited within the limits of New York. Provisions are made for the storage of calcium carbide in sealed receptacles in quantities not exceeding 100 lbs. in isolated buildings of fire-proof construction, and the storage must be with a permit from the Fire Department, and the entire quantity stored not exceeding 500 lbs. in the aggregate.

NEW COMPANIES REGISTERED.

Leecoll Electric Battery Company, Limited (60,187).—This company was registered on January 5th, with a capital of £60.000 in £1 shares, to acquire Patent No. 10,439 of April 27th, 1897, to adopt an agreement with Charles E. Lee, and to manufacture, sell and deal in lamps, electric batteries (primary and secondary), vehicles, carriages, cycles, horseless carriages, motor cars, motors, &c. The first subscribers (each with one share) are:—Arthur Drury, 1, Spencer Road, Acton, W., clerk; Arthur Beckett, 251, Mare Street, Hackney, N.E., clerk; J. Price, 17, Finsbury Pavement, E.C., accountant; Wm. L. Dunn, 71, Benthal Road, Stoke Newington, N., clerk; Edward F. Grainge, New Broad Street House, E.C., accountant; Frederick Wimp, 2, Alfred Villas, Walthamstow, accountant; H. Cornelius Pharash, 63, Beresford Road, Harringay Park, N., accountant. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £500 per annum and a share in the profits, divisible. Registered office, 14, Devonshire Square, E.C.

Nuneaton and District Light Railway Company, Limited (60,190).—This company was registered on January 5th, with a capital of £2,000 in £1 shares, to apply to the Light Railway Commissioners, the Board of Trade, or any other authority, for the construction and working of a light railway in Nuneaton, Warwickshire, and its neighbourhood, and to construct, equip, maintain, and work by electricity, gas, oil, steam, horse, or other power, any railways and tramways. The first subscribers (each with one share) are:—Augustine McSwiney, 4, Weston Road, Handsworth, Birmingham, engineer; A. D. E. Kires, 337, Balsall Heath Road, Birmingham, manager; J. H. Simmons, 41, Duckland Road, Birmingham, builder; Benjamin Price, 50, St. Paul's Square, Birmingham, merchant; Albert R. Morgan, 35, Shireland Road, Smethwick, secretary; Alexander Law, Kidderminster, contractor; George Law, jun., Malvern House, Holyhead Road, Handsworth, contractor. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Howell's Simplex Anti-inductive Telephone Syndicate, Limited (58,416).—This company's statutory return was filed on December 29th. The capital is £12,000, in 11,950 ordinary shares of £1 each, and 1,000 deferred shares of 1s. each; 2,840 of the former and 176 of the latter have been taken up, and the full amount called, resulting in the receipt of £2,848 16s.

River Po Electric and Power Syndicate, Limited (57,983).—This company's statutory return was filed on November 28th, when seven shares were taken up out of a capital of £10,000 in £1 shares, and paid for in full.

African Trans-Continental Telegraph Company, Limited (37,855).—This company's annual return was filed on January 2nd, when 154,980 shares were taken up out of a capital of £300,000 in £1 shares. £1 per share has been called, and £153,547 10s. paid, leaving £1,452 10s. in arrears. £10 has been paid on 20 forfeited shares.

Stock Exchange Settlements.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in and to grant a quotation to:—Potteries Electric Traction Company, Limited—13,334 ordinary shares of £10 each and 20,000 5 per cent. cumulative preference shares of £10 each. And (2) to allow the following securities to be quoted in the official list:—Brazilian Submarine Telegraph Company, Limited—Further issue of shares of £10 each. Edison & Swan Electric Light Company, Limited—Further issue of £150,000 4 per cent. debenture stock.

Direct United States Cable.—The board have resolved upon the payment of an interim dividend of 3s. per share, free of income-tax, being at the rate of 3 per cent. per annum, for the quarter ended December 31st last (such dividend to be payable on and after 31st inst.), setting aside £12,000 to reserve fund account, and carrying forward a balance of about £5,920.

Electric Construction Company.—The transfer books for the 4 per cent. perpetual first mortgage debenture stock will be closed from 9th to 14th inst., inclusive.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending January 7th, 1899, were £166 9s. 6d.; aggregate to date, £166 9s. 6d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending January 6th, 1899, were £2,506 4s.; corresponding period, 1898, £2,463 7s. 7d.; increase, £42 16s. 5d.

The City and South London Railway Company.—The receipts for the week ending January 8th, 1899, were £1,143; week ending January 9th, 1898, £1,124; increase, £19; total receipts for half-year, 1899, £2,179; corresponding period, 1898, £2,174; increase, £5. Miles open, 3¼.

The Dover Corporation Electric Tramways.—The receipts for the week ending January 7th, 1899, were £155 0s. 7d.; week ending January 8th, 1898, £117 11s. 10d.; increase, £37 8s. 9d.; Miles of track open week ending January 7th, 1899, 3; week ending January 8th, 1898, 3. Car miles run week ending January 7th, 1899, 4,179; week ending January 8th, 1898, 2,562. Number of cars week ending January 7th, 1899, 11; week ending January 8th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the six days ending Friday, January 6th, 1899, were as follows:—D. U. T. Co., horse cars, £1,732 8s. 5d.; ditto, electric cars, £461 4s. 2d.; D. S. D. Co., electric cars, £509 16s. 4d.; total, £2,703 8s. 11d; corresponding week last year—D. U. T. Co., horse cars, £2,412 12s. 3d.; ditto, electric cars, £94 9s. 3d.; D. S. D. Co., electric cars, £337 3s. 2d.; total, £2,844 4s. 8d.; decrease, £140 15s. 9d. Worked:—The mileage open is 16 miles electrically, 28 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for the week ending January 4th, 1899, were £265; total receipts to date, 1899, from June 29th, 1898, £7,118. Car miles run, 4,104. Miles of track open, 8¾. Number of cars, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending January 8th, 1899, amounted to £1,389: corresponding week last year, £1,438: decrease, £99.

The Mexico Electric Tramways Company.—Receipts for December, £15,500.

The South Staffordshire Tramways Company.—The receipts for 6 days ending January 6th, 1899, were £457 17s. 6d.; 7 days ending January 17th, 1898, £541 5s. 5d.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Jan. 4th.	Closing Quotation, Jan. 11th.	Business done during week ended Jan. 11th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104 xd	100 —104	102½	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	..
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	91 — 94 xd	91 — 94	...	..
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	...	66 — 68	66 — 68	66¾	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	...	116 —117	117 —118	118	117
3,047,220£	Do. do. Deferred...	Stock	...	...	...	16⅜— 17¼	17 — 17⅜	17⅜	17
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	...	15¼— 15⅜xd	15¼— 15¾	15¾	15⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114 xd	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2⅜— 3¼	2⅜— 3¼	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	180 —190	180 —190	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105 xd	103 —105	104½	104
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	...	...	3/16— 3/16	3/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	7 %	...	10 — 11	10 — 11	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	16½— 17½	17 — 18	...	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref. ...	5	10 %	10 %	...	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	...	104 —107%	104 —107%	...	...
60,710£	Direct United States Cable	20	2½ %	...	...	11⅜— 12¼	11⅜— 12¼	12⅛	11¾
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105 xd	102 —106	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	173 —178	174 —179	177	175
1,295,000	Do. 3½% Pref. Stock	100	...	...	...	104 —107	104 —107	105½	104¼
500,000	Do. Prov. Certs., 50 % paid	...	...	...	...	54 — 57	54 — 57	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	124 —128	124 —128	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	17½— 18	17½— 18	17 11/16	17 11/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103 xd	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103 xd	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	125 —129	125 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103 xd	99 —103	103	100
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	100½	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	104 —107	104 —107	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	104 —107%	104 —107%	105	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	...	12¼— 12⅜	12¼— 12⅜	12 11/16	12⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	16⅜— 17¼	16⅜— 17¼	17 1/16	16 15/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	28½— 29½	28½— 29½	28 13/16	28⅝
150,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	...	101 —104	101 —104	...	...
97,800	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	100 —103 xd	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	56 — 59	56 —59	57¼	57
100,000£	London Platino-Brazilian Telegraph, 6 % Debs. ...	100	6 %	6 %	...	109 —112	109 —112	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	6 %	...	5½— 5¾	5⅝— 5¾	5 11/16	5⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	13 — 15	13 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	13 — 15	13 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	...	5⅜— 5⅝	5⅜— 5⅝	5½	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	...	99 —102 xd	99 —102	102½	99½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	104 —107 xd	104 —107	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8 xd	6½— 7½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	134 —139	134 —139	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4½— 5	4½— 5	4⅝	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105 xd	102 —105	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105 xd	102 —105	...	...
64,269	Western and Brazilian Telegraph	15	2 %	3½ %	...	12¼— 12⅜	12¼— 12⅜	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	...	8 — 8½	8 — 8½	...	...
33,129	Do. do. do. Def. Ord.	7½	nil	½ %	...	4 — 4½	4 — 4½	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	105 —108 xd	105 —108	...	...
88,321	West India and Panama Telegraph	10	1 %	2 %	...	1⅞— 2⅛	1⅞— 2	2	1 13/16
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅜	10¼— 10¾	10½	10¼
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107 xd	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	...	11½— 12⅜	11½— 12⅜	12¼	12¼
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	...	9 — 10	9 — 10	...	...
60,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	..	113 —115	113 —115	113	...
50,000	City of London Electric Lighting rd. 40,001—90,000 ...	10	7 %	10 %	...	22 — 24	22 — 24	23	22⅞
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	21 — 23	21 — 23	23½	22⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	15½— 16½	15½— 16½	15⅝	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130 xd	125 —130	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	...	12½— 13½	12 — 13	12⅞	12½
10,000	Do. do. do. Nos. 30,001 to 40,000 ...	10	...	...	...	12 — 13	11½— 12½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	14½— 15½	14½— 15½	15	14⅜
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5 — 5½	5 — 5½	...	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	4 %	...	9 — 10	9 — 10	9¼	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9½— 10½	9½— 10½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3 — 3½	3 — 3½	3½	...
48,050	Do. do. do. 6 % Pref.	5	...	...	...	6 — 6½	6 — 6½	6 5/16	6⅛
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	102 —104	102 —104	103	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	...	17½— 18½	18 — 19	18⅜	18
22,500	Do. Nos. 62,501 to 85,000, £4 paid ...	10	...	...	...	... ...	10½— 11½	11⅜	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	115 —119 xd	115 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	...	17 — 18	17 — 18	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	...	16 — 17	17 — 18	17 1/16	16⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	9 — 10	9 — 10	9¾	9½
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	2⅞— 3⅛	3 — 3⅛	3⅛	3
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	...	15½— 16½	15½— 16½	16¼	16

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Jan. 4th.	Closing Quotation Jan. 11th.	Business done during week ended Jan. 11th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3½— 3⅝	3½— 3⅝	3½	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	15½— 16½	16 — 17	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13 — 13½	13 — 13½	13¼	13
100,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	..	...	...	119 —121	119 —121	120½	119½
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅝— 2	1⅝— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2½— 2⅝	2½— 2⅝	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104 xd	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	9½— 10½	9½— 10½	10⅜	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —113 xd	110 —113	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼xd	9⅜— 10½	10⅛	9 15/16
178,303	Do. do. do. £6 paid	10	...	...	...	5½— 6¼xd	5½— 6½	...	...
61,033	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅝xd	1½— 2	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4 — 4½xd	4 — 4½	...	...
630,000*l*	City and South London Railway	Stock	1 1/16 %	1⅛ %	...	67 — 69	67 — 69	69	68
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £4 pd.	10	...	...	...	3½— 4	3½— 4	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1¾— 2¼	2¼— 2⅝	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	89 — 94 xd	89 — 94	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2½— 2⅝	2½— 3	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	93 — 97	96 — 98	...	...
110,000	Electric Construction, 1 to 110,000	2	6 %	6 %	...	2¼— 2½	2¼— 2½	2 7/16	2 5/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	2⅝— 3¼	2⅝— 3¼	...	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	¼— ½	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	...	22 — 23	22½— 23½	23	22½
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	...	18 — 19	18 — 19	19	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21½— 22½	21½— 22½	22⅜	22¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3½%	...	10 3/16— 10 5/16	9 13/16— 10 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	...	14¾— 15¼	14¾— 15¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	...	37 — 41	37 — 41	39¾	38½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	...	102 —105 xd	104 —107	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	7 — 7½	7⅛— 8	7⅜	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5⅜— 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	111 —114	111 —114	113	112

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.

British Aluminium, Ordinary, 10—12; 7 % Pref., 11—13.

House-to-House, 4½% Debentures of £100, 103—106.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7¾—8¼. Debentures, 103—106%. Dividend, 1897, on Ordinary Shares 10%.

National Electric Free Wiring, 10s. paid, 5/16 to 7/16.

Smithfield Market Electric, 4—5.

*T. Parker, £10 (fully paid), 15⅞—16⅛.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (October 13th, 1898).

MARKET QUOTATIONS, Wednesday, January 11th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	37/-	37/-	..
a Ammonia, Muriate (grey) ..	per ton	£19	£19	..
a „ „ (white) ..	per ton	£26	£26	..
a Bleaching powder	per ton	£5 15	£5 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50,90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£20	£20 10	10/- dec.
a Lead, Nitrate	per ton	£23	£23	..
a „ White Sugar	per ton	£30 10	£30 10	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¾d.	8¾d.	..
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	65/-	65/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 15	£6 15	..
a „ Recovered	per ton	£5 15	£5 15	..
a „ Lump	per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	3d.	3d.	..

METALS, &c.		This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots..	per ton	£191	£191	..
c Brass (rolled metal 2" to 12") basis	per lb.	7d.	6¾d.	¼d. inc.
c „ Tube (brazed)	per lb.	8¾d.	8¼d.	¼d. inc.
c „ Wire, basis	per lb.	7¼d.	7d.	¼d. inc.
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£70	£68	£2 inc.
g „ Wire (basis price) ..	per lb.	8¼d.	8d.	¼d. inc.
g „ Sheet	per ton	£70	£68	£2 inc.
g „ Rod	per ton	£70	£68	£2 inc.
m German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	5/9 to 6/-	only 3 tons obtainable
h India-rubber, Para fine ..	per lb.	4/-	4/1	1d. dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	45/1	44/3	10d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	45/-	45/-	..
i „ Wire galvanised No. 8 ..	per ton	£8 15	£8 15	..
g Lead, English Ingot	per ton	£13 15	£13 7 6	7/6 inc.
g „ „ Sheet	per ton	£14 10	£14 5	5/- inc.
l Mica (uncut slabs 8" long) ..	per lb.	6/6	6/6	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£8	£7 15	5/- inc.
o Platinum	per oz.	£8 1 6	£8 1 6	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£101	£91 10	£10 10 inc.
g „ foil	per lb.	1/4	1/3	1d. inc.
n „ wire Nos. 1 to 16	per lb.	1/5	1/5	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	6½d.	6½d.	..
j „ Flax, 6 or 8 lea... ..	per lb.	3½d.	3½d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£12	£12	..
j „ Manila, 24 thread ..	per ton	£29	£29	..
k Zinc, Sheet (Vielle Montagne bnd.)	p. t.	£28	£29	£1 dec.

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „
e „ „ „
f „ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
g „ „ „ Messrs. James & Shakspeare
h „ „ „ „ Jackson & Till
i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ „ P. Ormiston & Sons.
o „ „ „ „ Johnson, Matthey & Co., Ltd

INSTITUTION OF ELECTRICAL ENGINEERS.

"Electric Intercommunication in Railway Trains." By W. E. Langdon, Vice-President. Paper read December 15th, 1898.

(*Concluded from page 28.*)

Considerations.

We have now arrived at a point when we may, perhaps, with advantage take into consideration the material points.

We have before us, broadly, the principles of the electric systems in use, as well as those experimentally established. What, then, are the principles which may be suggested as those which should underlie the provision of this means of communication?

Experience tells us, and the Board of Trade Report suggests, that *the communication should be of such a character as to lend itself readily to the interchange of carriages between different railways* This involves not only the electrical principle, but the mode and form of coupling, as well as the means of restoring the communication to its normal condition. The electrical system must be such as will conform to that in use on other lines of railway. We have seen that all those systems in use do practically stand upon a common basis. They have either one insulated wire, and an earth or an uninsulated "return," or two insulated wires. They differ to the extent of some switching arrangements, but it will be clear that that method, which involves no special provision in respect of the position which the van occupies in the train, is that which must commend itself for adoption. To modify the arrangements of those vehicles which do not conform to this demand would be an extremely small matter. It would also be better, as has already been explained, to employ an insulated "return;" but it is possible, though not desirable, to use an open "return."

That the coupling for any electrical communication which might be established on railway trains should be combined with one of the mechanical couplings seems to be a sort of tradition handed down from those days preceding the period when railway companies found marshalling sheds indispensable. We have seen that the companies who have used an electrical communication have for years employed an independent coupling, and that they are now supplementing this by a second. The "cord" communication calls for coupling up, and certainly the time required for connecting together an electrical coupling cannot be so great as that now incurred in connecting up this "cord" communication. The question, moreover, is one which, in respect of the majority of trains, does not in any way affect platform work, for the reason that the trains, as a rule, come to the platform ready coupled up.

It may, and very naturally, be asked: But why, if the two couplings—the electric and the brake—can be combined, should they not? The question which here arises is mainly one of responsibility. A question on the cost and convenience will naturally also present itself, but that of responsibility is unquestionably the most material. Will such a combination lessen the responsibility which attaches to the efficient maintenance of the brake? When a failure arises in a brake coupling or tube, how is it to be dealt with without the presence of the electrical attendant, and *vice versâ*? Are these men to hunt in couples—the one tied to the other? What does such a combination entail? It means the replacement of some 150,000 brake couplings and tubes. Will the cost prove more economical, or so economical as if the two were established and maintained independent the one of the other, leaving the two departments freedom of action and individual responsibility? I advance these remarks from conviction, after mature consideration, that to combine the electrical with the brake coupling is, on many counts, undesirable.

It has already been demonstrated that but one coupling for the two wires composing the communication, is necessary. That the handling of this coupling is a perfectly simple and easy matter will be evident from an examination of the sample on the table.

In the early portion of the paper it was suggested that, in their adoption of the mechanical cord, railway companies were animated by a desire to provide for the possibility of a derangement of the train more than with a view to the question of outrage. Improvements in the lubrication of axles, in points and crossings, in the permanent way, and in the rolling stock generally, render the conditions of railway travelling to-day incomparable with those of 1868. Derangement of a passenger train in motion is now a most unusual occurrence. Unhappily, violence and outrage still exist. In viewing this question it would appear that that which has now to be chiefly provided for is the protection of the traveller from outrage. Is this adequately provided for by the provision of a means of raising an alarm from one position only in each compartment? It is due to the conviction that this is not so, and that the only effectual mode of doing so is the provision of a means of communication in the neighbourhood of each corner of a compartment, that I have endeavoured to evolve the method referred to as that which has been applied to a Midland train

Although seemingly a very small matter, there is another phase of the question which is material to the adoption of an universal system, viz, the means by which the communication, once used, is restored. This is done by a key carried by the guard. It is usually of private construction, and differs with most companies. It should be common to all, otherwise guards will require to be furnished with a key applicable to each of the companies' stock which may pass over the line upon which he is engaged.

Other points of equal, although not of universal, importance will no doubt present themselves: the description of wire to be used; whether it shall be insulated with gutta-percha or rubber; the character of the indicator, of the commutator, the description of battery, &c.—all questions of moment, but not vital to the question of interchange of stock. In relation to that we have to bear in mind that it involves three fundamental principles, viz.:—

1. The electrical system.
2. The form of coupling.
3. Uniformity of releasing key.

That one system should be adopted throughout, even in matters of detail, is, of course, to be desired, but uniformity in the three points named are essential to an interchange of stock.

There remain but two more points at which to glance, viz, communication with the driver, and provision for calling attention to the division of a train when in motion.

There is no difficulty in providing for communication with the driver, but it is desirable the battery on the engine should be dispensed with. This it is possible to effect by providing each guard's van with a coupling applicable to the locomotive. The cost of adopting this course would be less than that attending the provision and maintenance of a battery on the engine. Another point is, whether it would not be better to sound a whistle on the engine, rather than operate a bell. The whistle would probably be easier to maintain.

In the earliest established electric communication systems a means was provided for claiming attention should a train become severed. There is no difficulty attending this, but it would appear that the need for it no longer exists. Since those days the automatic brake has been introduced, and if a train should at any moment become divided, the progress of all portions of it would at once be arrested.

The title of this paper indicates that its purpose is to treat of the subject from an electrical point of view. Reference has, however, been made to the fact that there is in use another means of claiming the attention of the guard, viz., a partial use of the automatic vacuum brake. Each compartment of a carriage is provided with a means of opening a small valve connected with the brake pipe. To what extent this is effective—whether it varies with the speed of the train or other conditions, or whether such a system is a desirable one—I am not in a position to say, and I only refer to it here in order to point out that, should an electrical system be adopted, carriages provided with this means of applying the brake could be looped in on electrically fitted trains by means of a loose coupling; but there would be a difficulty in dealing with electrically fitted vehicles interposed in trains worked under this partial application of the brake system.

In concluding this paper, I desire to tender to the general managers and to my *confrères*, the electrical engineers, of the various railways, who have so kindly assisted me with information, my most hearty and respectful thanks.

RAILWAY PASSENGER COMMUNICATION.

Extracts from the Report of the Committee appointed by the President of the Board of Trade.

Systems in Use on Railways in Other Countries.

The Committee thought it desirable to ascertain the means of communication used on railways in other countries, and they therefore requested the Board of Trade to obtain for them through the Foreign, Colonial and India Offices information as to the means adopted on the principal railways in Austria-Hungary, Belgium, France, Germany, Italy, Russia, Switzerland, the United States of America, Canada, New South Wales, and India.

The replies received show that in Austria all fast and express trains are fitted with an electrical communication (system Rayl). In Hungary the use of corridor carriages is said to be nearly universal, and when these are fitted with an automatic brake, means are provided to enable the passengers to apply it, and thus call the attention of the servants in charge of the train, and no further means of communication is thought necessary. A system of electrical communication was formerly employed, but it has gone out of use since automatic brakes were generally adopted on main lines. In Belgium a means of communication by the application of the Westinghouse brake, similar in principle to that used in connection with the vacuum brake by the Great Central and other railways in this country, is in force on the State railways; and it is instructive to note that it was thought desirable to increase the size of the valve through which the air escapes from the brake pipe, when the brake is applied by a passenger, so as to ensure the speedy stoppage of the train. The same arrangement is used on the principal Italian railways. In France, the system to be adopted is left to the discretion of the individual companies, some of which employ electrical means, generally "Prudhomme's" system, whilst others prefer the Westinghouse brake system.

In Germany almost all passenger trains are fitted with automatic brakes, and means are provided to enable passengers to apply the brake in case of emergency.

In Russia and Switzerland corridor carriages are generally used, and, when automatic brakes are provided, passengers can apply them.

In Canada there is direct means of access from one part of a train to another, each carriage being connected to the next by a gangway, but a cord runs through the train by which a signal to stop can be conveyed to the driver.

In India various means of communication have been tried, but the Indian Government state that the only one that has given satisfaction is an electrical method, invented by the late Mr. G. K. Winter. This system, in which the electric connection between the carriages is made by means of the side or safety chains, has been in use on the Madras Railway since 1880, and is being introduced on the South Indian Railway.

Conclusions as to Existing Systems.

Most of the witnesses examined by the Committee agreed that the ordinary means of communication by means of a cord outside the

carriage is unsatisfactory, and with these opinions your Committee entirely concur.

Owing to the difficulty of obtaining access to the cord in cases of emergency, and to the uncertainty of its action when pulled, this system cannot be regarded as affording a reliable means of communication, and the Committee have no hesitation in condemning it.

Some advantages over this system are no doubt possessed by those in which a cord or wire passes inside the carriages, but the Committee cannot hold that they are satisfactory.

As regards the electrical systems of communication referred to above, the Committee had the advantage of making trial of that in use by the London, Brighton and South Coast Railway Company, on a train placed at their disposal by the company. They found it to work efficiently, whilst the company, as previously mentioned, have no record of its having ever failed.

Evidence was received by the Committee indicating that the electrical methods in use on the South-Eastern, and London, Chatham and Dover Railways, had given satisfactory results.

The Committee also had an opportunity of inspecting an electrical system fitted by the Great Eastern Railway Company to one of their trains, in which the wires are carried along the brake pipes, and the coupling of the pipes between two carriages automatically gives the necessary connection between the wires. This system worked satisfactorily when tested, and it has the advantage of obviating the necessity for any additional coupling—a point which the Committee think will be found of considerable importance to railway companies in working their traffic.

The Committee are of opinion that all these electrical systems, though some of them may be capable of improvement, may be considered as providing efficient means of communication.

The London and South-Western Railway Company have been good enough, at the request of the Committee, to fit up a train with a somewhat similar system, in which the electrical connection between the carriages is made by coupling the side chains.

The system was invented by the late Mr. G. K. Winter, and, as has already been stated, is largely used in India.

As the train has only recently been fitted with the apparatus there has not been time for a prolonged trial of the system, but, so far as the tests have gone, they have, we understand, been satisfactory.

The conducting surfaces, however, being open to the atmosphere and to dust or snow, are not likely, in the opinion of the Committee, to be as efficient as those which are placed within the brake coupling.

A system of communication by means of the automatic brake has been applied in this country only on trains using the vacuum brake.

APPENDIX.

Table I.—Passenger Rolling Stock.

English and Welsh Railways.

Railway company.	Engines.	Coaching.								Total coaching (exclusive engines).
		Saloons.	1st.	2nd.	3rd.	Composites.	Vans.	Horse boxes.	Carriage trucks.	
Brecon and Merthyr	31	2	9 1st	and 2nd	33	4	5	1	1	55
Cambrian	71	...	14	...	110	72	38	23	6	263
Cheshire Lines	...	...	67	58	177	37	16	35	31	421
East and West Junction	...	...	...	...	4	4	3	..	...	11
Furness	124	5	...	...	190	70	47	27	30	369
Great Central	775	3	53	...	710	194	82	53	24	1,119
Great Eastern	993	37	437	436	1,492	916	367	422	241	4,348
Great Northern	1,069	127	100	156	1,323	579	284	240	145	2,954
Great Western	1,863	...	259	179	2,623	1,160	1,114	598	352	6,285
Hull, Barnsley and West Riding Junction ...	75	2	...	...	47	24	12	10	6	101
Lancashire, Derbyshire and East Coast ...	16	1	...	...	39	8	13	8	4	73
Lancashire and Yorkshire	1,256	...	244	137	2,124	628	221	134	136	3,624
London, Brighton and South Coast	463	...	379	245	1,178	454	382	216	146	3,000
London, Chatham and Dover	210	22	244	224	442	75	173	35	21	1,236
London and North-Western	2,385	...	1,910	230	2,231	(Included in 1st class)	894	651	1,000	6,916
London and South-Western	702	79	312	110	1,175	674	874	290	150	3,694
London, Tilbury and Southend	42	3	54	...	237	16	17	6	...	333
Metropolitan	80	2	62	85	163	44	6	3	2	367
Midland	2,360	...	295	...	1,890	936	685	443	546	4,795
Midland and South-Western	18	...	...	...	10	16	7	19	2	54
North-Eastern	1,963	...	160	16	1,986	509	407	395	164	3,637
North Stafford	153	4	11	13	189	58	25	30	21	351
South-Eastern	439	1	375	255	867	176	397	117	141	2,329
Taff Vale	193	...	5	7	130	47	36	11	8	244
To'als	15,286	288	5,020	2,151	19,370	6,701	6,105	3,767	3,177	46,579

Scotch Railways.

Caledonian	788	...	277	...	1,115	297	206	1 6	41	2 052
Great North of Scotland	112	...	75	...	284	51	62	16	13	501
Glasgow and South-Western	345	...	181	...	563	104	120	82	101	1,151
Highland	133	2	54	...	167	49	71	25	20	388
North British	740	...	407	...	1,282	140	288	177	481	2,775
Totals	2,118	2	994	...	3,411	641	747	416	656	6,867

Irish Railways.

Belfast and County Down	29	...	22	23	64	44	8	8	1	170
Belfast and Northern Counties...	73	...	10	6	124	77	32	23	8	280
Cork, Bandon and South Coast...	18	3	...	...	27	14	6	4	2	56
Donegal	9	...	...	..	10	9	9	3	5	36
Dublin, Wicklow and Wexford	58	...	48	73	101	12	41	18	6	299
Great Northern	145		36	20	181	87	87	95	43	549
Great Southern and Western	178	1	50	34	178	76	98	86	32	555
Midland Great Western...	127	1	25	25	93	38	61	60	24	327
Waterford, Limerick and Western	58	...	2	...	59	37	13	22	7	150
Totals	695	5	193	181	837	394	365	319	128	2,442

English	15,286	288	5,020	2,151	19,370	6,701	6,105	3 767	3,177	46,579
Scotch	2 118	2	994	..	3,411	641	747	416	656	6,867
Irish	695	5	193	181	837	394	365	319	128	2,422
Totals	18,099	295	6,207	2,332	23,618	7,736	7,217	4,502	3,961	55,868

Table II.—Daily Test of Batteries joined up in Parallel, October 18th to November 20th, 1897.

Date.	Bichromate 2-quart cells.						Leclanché No. 1 cells.					
	1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.	6.
1897.												
October 18th	1·30	1·75	1 75	1·70	1 70	1 65	1 35	1·45	1·45	1 40	1·45	1 45
,, 19th	1 35	1·70	1·75	1 65	1 70	1 60	1 35	1 45	1 45	1·40	1·45	1·45
,, 20th	1·38	1 75	1·75	1 65	1·65	1 60	1 35 bare	1 45	1·45 bare	1·40	1·45	1·45
,, 21st	1·43	1·70	1 70	1 65	1 70 bare	1 62	1·30	1·45	1 40 bare	1·40 bare	1·45	1 40
,, 22nd	1·45	1·70	1 75	1 70 bare	1·70	1·65	1·30	1 45	1·40	1·40	1·45	1·45 bare
,, 23rd	1·45	1 70	1·75	1 70 bare	1 70	1 65	1·30	1 45	1·40	1·40	1·45	1·45 bare
,, 25th	1·55	1 80	1 80	1·75	1 70	1 65	1 30	1 45	1·45 bare	1·45 bare	1·45	1·45
,, 26th	1·50	1·80 bare	1·80 bare	1 75	1·70	1 65	1 30	1·50 bare	1 40	1·45 bare	1 45	1 45
,, 27th	1 50	1·75	1·75	1·70 bare	1 70	1 65	1·30	1·45	1·40	1·40	1 45	1·45
,, 28th	1·50	1·75	1 75	1·70 bare	1 70	1·65	1·30	1·45	1·40	1·40	1·45	1·40
,, 29th	1·50	1·75	1 80 bare	1 70	1·75 bare	1 65	1·35 bare	1·45	1·40	1·40	1 45	1·45
,, 30th	1 55	1 75	1·80 bare	1·70	1·75 bare	1·65	1 35 bare	1·50	1·40	1 40	1·45	1 45
November 1st	1·55	1·80	1 80	1 70	1 75	1 65	1 35	1 55 bare	1 45 bare	1 45 bare	1 45	1·45
,, 2nd	1·55	1 80 bare	1 75	1 70	1·70	1·65	1·35	1 50 bare	1 45	1·45 bare	1·45 bare	1·45
,, 3rd	1·55	1·80	1·70	1 75	1·70	1 65	1·35	1·50	1 45	1·45 bare	1·45	1·45
,, 4th	1·55	1·80	1·75	1 70	1·70	1 65	1·35	1·50 bare	1 45	1·40	1·45	1·45
,, 5th	1·55	1·80	1·75	1·70	1·75 bare	1 65	1·35	1·45	1·45 bare	1·40	1·45	1·45
,, 6th	1·60 bare	1·80	1·80	1 70	1 75	1 65	1·35	1·50 bare	1 45	1 45	1·45	1·45
,, 8th	1 65	1 90 bare	1·85 bare	1·75	1 80 bare	1 70	1 35	1 50	1·45	1 45	1·50 bare	1·45
,, 9th	1·60 bare	1 80	1 75	1 70	1 70	1 65	1·35	1 50 bare	1·40	1 40	1·45	1·45
,, 10th	1·65	1 90 bare	1·80 bare	1 75	1·75	1·70	1·40 bare	1·50	1 45	1·45	1·45	1·45
,, 11th	1·60	1·90 bare	1·80	1·75	1 75	1 70	1 35	1·50	1·45	1·45	1·45	1·45
,, 12th	1·60	1·85	1·80	1 75 bare	1·75	1·70	1·40 bare	1·55 bare	1·45	1 45	1·50	1·50 bare
,, 13th	1·60	1·90	1 80	1·75 bare	1·75	1 70	1·35	1·55 bare	1·50 bare	1·45	1·50 bare	1·45
,, 15th	1·60	1·90 bare	1 85 bare	1 70	1 75	1 70	1 40 bare	1·50	1 45	1·45	1 50	1 45
,, 16th	1·60	1 90	1·80	1 75	1 75	1 70	1 40 bare	1·50	1 45	1·45 bare	1 45	1·45
,, 17th	1 60 bare	1 90	1 80	1 70	1·75	1 70 bare	1 40	1 50	1·40	1·45 bare	1·45	1·45
,, 18th	1·60	1·95	1 80	1 70	1 75	1 65	1·40	1 50	1 45	1 45	1 45	1·45 bare
,, 19th	1 60 bare	1 90	1·80	1 70	1·70	1 65	1·40 bare	1·50	1·45	1·45	1·45	1·45
,, 20th	1·60	1 90	1·85 bare	1 75	1 80 bare	1 65	1·40	1·50	1·45	1 45	1·45	1 45

Through the kindness of the Great Central Railway Company, the Committee have had an opportunity of practically testing this method of communication. It worked satisfactorily, and companies by whom it has been adopted speak of it in the highest terms. One of its greatest advantages is that each carriage is complete in itself, and the coupling of the brake pipes between two carriages of necessity connects the means of communication. It has also been pointed out to the Committee that, in the case of interchange rolling stock fitted with both the vacuum and Westinghouse brakes, the same apparatus within the compartment can be made to actuate valves connected to either brake pipe, so that whichever brake is in use, the means of communication is available.

As already stated, the system is largely applied on Continental railways to the Westinghouse brake, and appears to have given satisfaction; but in the opinion of the Committee, it would be improved by an additional arrangement, by which the attention of the driver and guards might be audibly called to the signal, and by which drivers and guards could communicate with each other.

It has been suggested that the increasing use of corridor or other similar carriages will do away with the necessity for means of communication, but the Committee cannot agree with this view, as they are of opinion that some method of communicating with the driver and guards is as necessary upon corridor as upon other trains.

Your Committee have carefully considered the second point referred to them, viz, whether any system in use or available is so efficient as to make its general adoption desirable.

The Committee do not think that any one of the electrical systems of communication in use at the present time possesses such advantages over the others or over the brake system as to justify them in recommending it for general adoption.

On the other hand, many railway companies entertain a strong objection to granting to a passenger even a limited control over the brake, and the Committee do not think that a system which involves the grant of such a control, however efficient it may be, should be pressed upon a company against the advice of its responsible officers.

Of systems not in use, but available, the Committee have had a number brought before their notice. Many of these are very ingenious, and do credit to their inventors, but they have in most cases been anticipated by other inventions, and either closely resemble or possess no great advantage over means now in use.

Conditions which a Method of Communication should Fulfil.

The following are the conditions which it appears to the Committee a method of communication should fulfil to be entirely satisfactory:—

1. It should be one which would lend itself readily to the interchange of carriages between different railways.

2. It should be easily applicable, and should communicate directly with the driver as well as with the guards, whilst the means by which it is actuated by the passenger should be in a conspicuous position, either in the centre, or at both ends of the compartment, without affording too great a temptation to passengers to tamper with it.

3. It should be reasonably cheap, as to both initial cost and maintenance.

4. It should afford an indication outside the carriage of the compartment from which the communication has been made, and a passenger should not be able to replace the means by which the alarm is given.

5. It should not entail the use of additional couplings to those

already existing, viz., the screw coupling, the side chains, the automatic brake, and the heating apparatus (where in use).

6. It should be capable of being used as a means of communication between the driver and guards of a train, as well as between the passengers and the driver and guards.

Extension of the Existing Law.

The Committee were also directed to consider whether any extension or amendment of the law on the subject is desirable, and to this point they have given careful attention.

Under the present law, means of communication need only be provided on trains running 20 miles without stopping. It is obvious, however, that serious harm can be done, either by accident or design, in a journey of much less duration. Experience has, unfortunately, shown that a very short journey affords sufficient time to enable murder and outrage to be committed.

Several railway companies have already fitted, or are fitting, means of communication to all their trains, irrespective of the distance to be run without a stop, and representatives of other companies agreed in evidence that such an extension was reasonable.

The Committee are of opinion that the law should be so amended as to require efficient means of communication to be provided on all passenger trains.

Conclusions.

On the three points to which the inquiry of the Committee was directed, their conclusions may therefore be summarised as follows:—

I. That of the methods of communication at present adopted, the outside cord system should be condemned as inefficient, while the systems in which the cord or wire is inside the carriages cannot be regarded as satisfactory. The principal electrical systems and the communication by means of the brake may, however, be held to be efficient.

II. That no one of the electrical systems so far excels the others as to enable the Committee to recommend it for general adoption, although they prefer the system of communication described above as experimentally used on the Great Eastern Railway.

III. That the law should be extended so as to require the provision on all trains of an efficient means of communication between passengers and the servants in charge of the train, which could also be used as a means of communication between the guards and driver.

"Improvements in Magnetic Space Telegraphy." By Dr. Oliver Lodge, F.R.S., Member. (Paper read December 8th, 1898).

(*Continued from Vol. 43, page 995.*)

Part II.

Preliminary Experiments.

I will relate briefly a selection from some of the early experiments made on simple wire circuits, at first often without condensers, in order to find what sort of value of mutual induction coefficient (M) was sufficient to give audible signals between a couple of coils of wire lying horizontally in the same plane.

1. Two coils of thin wire, each of 350 turns, and 30 cm. (1 foot) diameter, with 5 amperes maintained in one at a frequency of about 100 by an alternating dynamo; a telephone connected to the other coil responded audibly when it was at 6 metres distance. The M in this case is 287 C.G.S., which is large, but no capacity was used to assist.

2. Two coils of No. 15 wire, each of 8 turns, on a hoop 92 cm. (1 yard) in diameter, and with 11 amperes maintained in one at a frequency of 120 by means of a make-and-break tuning fork; a telephone in the other responded at 3½ metres. In this case the M = 67 C.G.S.

3. A pair of coils in separate buildings 100 metres distant, each with a condenser, the transmitter being 60 turns of No. 18 wire round a small room nearly 4 metres square, the receiver being one of the above hoops a yard across wound with 8 turns of wire; the hum could be just heard. The M in this case is only 0·6 C.G.S., which is good.

4. The next experiment is worth quoting in fuller detail. It was made in 1897, a month or so later than the above-called (1) when things had improved. Below is a diagram of the connection at the sending end; the dynamo being replaced by a tuning-fork intermitter (all kind of intermitters have been used in different experiments).

F is the Koenig fork on its massive stand, vibrating 111 complete swings a second.

b is a single storage cell, and M is the magnet and vibrating solid contact to maintain the fork's motion.

H is the mercury cup contact for the main current.

B is a battery of 16 storage cells.

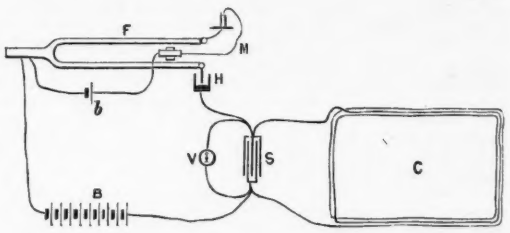
S is a condenser of variable capacity, and C the coil of 60 turns approximately 4 metres square.

V is a voltmeter to indicate the potential difference at the terminals of the condenser.

The self-induction of the coil being calculated roughly as 0·06 henry, the appropriate capacity for tuning, to the fundamental and the different harmonics, would be:—

For the note	111	per second,	S should be about	35	mfd.
" "	222	"	" " "	8·6	"
" "	333	"	" " "		"
" "	444	"	" " "	2·2	"

Practically it was found that 2·0 microfarads gave excellent tuning sending up the voltmeter to 98 volts, though the applied E.M.F. was only 32 volts. And under these conditions the note of 440 could be distinctly heard in the small coil in the distant tower; and by introducing a key into the sending circuit, without interfering with the continual vibration of the fork, messages could be sent and read with ease.



The receiving circuit was about 100 metres distant, high up in the College clock tower across the quadrangle, as in the last experiment; but the small hoop coil was replaced by a square coil of 22 turns of No. 18 wire about 3·8 metres square, whose L was therefore 0·008 secohm. A capacity of 16 microfarads was needed to attune the circuit to the note listened for.

5. Instead of any maintained alternator or intermitter of any kind, the make and break, or the reversals, of a signalling key were sometimes used alone to do the whole thing; and when a battery such as 144 very small Planté cells was employed, the induction ticks heard in the secondary at each charge and discharge of the primary condenser sufficed to give clear signals at a moderate distance, on the "sounder" plan, the beginning and end of each long and short signal being marked.

6. Another method is to have a much better insulated wire for the primary coil, and to discharge round it a Leyden jar with a short spark gap excited by a Rhumkorff coil; the spark being made whistling by a moderate glass-plate condenser (see "Modern Views of Electricity," Lecture III., page 435, second edition), the shrill momentary sounds can be heard in a suitable distant telephone and coil.

7. A pair of coils nearly 2 miles distant were now arranged, the transmitter being a rough square 100 yards across with five turns of four No. 16 wires in parallel, and the receiver being a long rectangle of the same periphery, about 30 yards wide, consisting of 19 turns of No. 18 wire. A dynamo with a multiple armature was employed, which was coupled up so as to give a nominal voltage of 175 volts (240 as measured). Nothing could be heard at the distant station without condensers, although the M = 10 C.G.S. This was expected, because of the high impedance and resistance. But when condensers were added at both ends and adjusted for resonance to the first harmonic—about 200 per second—the tone became faintly audible. The transmitting condenser was 10 microfarads, viz, four 5-microfarad condensers, two in parallel and two in series, which, by resonance, ran the effective voltage up to 1,100 volts; and the receiving condenser was 2 microfarads, shunted by an ordinary 70-ohm Bell telephone.

The self-induction of the sending cable was in this case 0·02 secohm, to which has to be added 0·04 secohm for the dynamo; while the resistances were 4 ohms for cable and 1 ohm for dynamo. So the reactance part of the impedance for the octave frequency was nearly 80 ohms, and the current therefore only about 3 amperes without sending condenser. A condenser magnified it four or five-fold. The sending condenser can always be replaced by a dynamo of higher voltage; but, on the other hand, given any dynamo, a sending condenser will increase its power, except on circuits whose resistance, and therefore damping, is excessive.

The self-induction of the receiving cable, as connected, was ⅓rd secohm approximately, and its resistance was 133 ohms. Even here, therefore, the impedance was more due to self-induction than to resistance, the value of p L being 410 ohms, and so the condenser was a great advantage. In fact without it nothing could be heard, with the given amount of power expended.

It may be serviceable here to show how quickly to calculate the frequency for any given self-induction and capacity.

Let L be expressed in secohms or henries; let S be expressed in microfarads; then the resonance frequency of the circuit is

$$\frac{160}{\sqrt{(L\,S)}}.$$

So in the above case the syntonised sending frequency comes out,

$$\frac{160}{\sqrt{(0{\cdot}06 \times 10)}} = 208 \text{ per second};$$

the syntonised receiving frequency,

$$\frac{160}{\sqrt{(0{\cdot}32 \times 2)}} = 200;$$

and the fundamental note of the dynamo oscillated about 100.

The damping term of these particular cables, viz., $\frac{R}{L}$ is, however, certainly too high, and the wire used for such large circuits ought certainly to be thicker than No. 18 or 16. Coupling up the strands of wire in a telephone cable in different ways does not affect the

damping constant, for the R and the L vary similarly; but the power of coupling them up differently is often convenient in enabling tuning to be got with a moderate condenser capacity, and, in general, in giving an adjustment for different notes. Otherwise, greater number of turns has just the same effect as thicker wire; it is simply *mass of copper* which is required to increase the power of a circuit to send or receive over big distances, and telegraphy over any distance by this method becomes, therefore, chiefly a matter of cost.

It may be well here to give the elementary theory of induction between a pair of circuits, each with condensers, especially for the case where the circuits are syntonised to the applied frequency.

Consider a circuit with self-induction and resistance and capacity, driven by an alternator of E.M.F. $= E \cos p t$: the primary current in it is

$$C = \frac{E \cos (p t - \alpha)}{\sqrt{\left\{ R^2 + p^2 \left(L - \frac{1}{p^2 S} \right) \right\}}},$$

where the lag α is given by

$$R \tan \alpha = p \left(L - \frac{1}{p^2 S} \right).$$

If there is exact tuning ($p^2 S L = 1$) the lag vanishes, and the current becomes

$$C = \frac{E \cos p t}{R},$$

its maximum value.

On a distant circuit with mutual coefficient M the induced E.M.F. is $M C$, or, in the above case,

$$M p \frac{E}{R} \sin p t;$$

so the induced current there is

$$x = \frac{M p \frac{E}{R} \sin (p t - \epsilon)}{\sqrt{\left\{ R'^2 + p^2 \left(L' - \frac{1}{p^2 S'} \right) \right\}}};$$

which, if again there be tuning ($p^2 S' L' = 1$), becomes

$$x = \frac{M p E \sin p t}{R R'} \qquad (3)$$

Let a cable contain $N = n m$ turns of wire, of resistance ρ_1 per unit length, coupled n in series and m in parallel, and be laid round a circuit of radius a: then

$$x = \frac{n n' \pi^2 \frac{a^2 b^2}{r^3}}{\frac{n n'}{m m'} 2 \pi a 2 \pi b \rho_1 \rho_1'} p E \sin p t$$

$$= \frac{m m'}{4} \cdot \frac{p}{\rho_1'} \cdot \frac{a b}{r^2} \cdot \frac{E}{\rho_1 r} \sin p t$$

$$= \frac{a b}{4 r^2} \cdot \frac{p}{R_1'} \cdot \frac{E \sin p t}{r R_1} \qquad (4)$$

where R_1 is the resistance of unit length of the cable itself as connected.

Here the last factor in (4) is the maximum strength of current which the dynamo could send direct to the distant station if its cable were long enough to reach all the way, and if it were opened out as connected and laid straight, all the parallel turns parallel and all the series turns end to end; and with all the remaining self-induction impedance abolished by a suitable very large condenser.

The actual current received inductively is therefore a definite fraction of this direct line current: the fraction depending on the linear dimensions of each circuit compared with the distance, and on the frequency, and on the effective thickness of the receiving cable.

Suppose we tried to signal a distance of 12,000 kilometres (across the earth) with a pair of No. 0 equal cables, each once round an area comparable to England, say, a circle 200 kilometres in diameter, using a frequency of 1,000 and an applied voltage of 200; ignoring all hysteresis and other losses (which in condensers are often important), and ignoring also the conductivity of the earth, which may be very troublesome:

$$\frac{E}{R_1 r} = \frac{200}{0{\cdot}322 \times 12{,}000} = \frac{1}{20} \text{ ampere};$$

$$\frac{p}{R_1} = \frac{1{,}000 \times 2\pi}{3{,}220} = \frac{2\pi}{3};$$

$$\frac{a b}{4 r^2} = \frac{100 \times 100}{4 \times (12{,}000)^2}.$$

These are the three factors; so the induced telephone current is about 2 microamperes, which is within the limit of audition.

The self-induction of such a cable would be between 2 and 3 secohms, its resistance about 200 ohms, and the capacity needed only about $\frac{1}{100}$ microfarad.

This arithmetic is a mere illustration of what would happen if everything were favourable.

Consider further the arrangement of coils adapted to really distant syntonic magnetic space telegraphy with very precise tuning. The mutual induction coefficient depends upon $n n' a^2 b^2 / r^3$; or for similar equal coils, each of periphery l and n turns,

$M r^3$ = the effect of the coil at a given distance $= n^2 l^4$.

The amplitude of disturbance maintained by an alternator of frequency p and voltage E_0, in a circuit whose natural frequency $p_0 = \frac{1}{\sqrt{(S L)}}$, may be written,

$$\frac{E_0/R}{\sqrt{\left\{ 1 + \frac{L}{S R^2} \left(\frac{p}{p_0} - \frac{p_0}{p} \right)^2 \right\}}},$$

which in case of exact resonance becomes E_0/R. Hence, to make resonance *sharp*, the coefficient $\frac{L}{S R^2}$ must be great. If this condition is not satisfied there will be a considerable range of resonance within which some exaltation of voltage is felt, but no decided peak; whereas, if $L/S R^2$ is great compared with the period of one oscillation, then except at a particular frequency the circuit is nearly inactive, but as the correct frequency is approached the activity of the circuit suddenly runs up to a high steep maximum, and condensers are liable to be burst by the immense and rapid magnification of voltage.

Take the case of approximate resonance, so that $p^2 S L = 1$ nearly, and introduce this value of S: then the coefficient which has to be big is $\frac{p^2 L^2}{R^2}$; *i.e.*, for a given frequency simply the damping constant or logarithmic decrement, R/L, must be small, or the current-decay time constant, L/R, big, compared with the frequency time constant. Now

$$\frac{L}{R} = \frac{n^2 l \left(\log \frac{3 l}{c} - 2 \right)}{\frac{n l}{c^2}} = n c^2 \text{ approximately},$$

where c is the thickness of the wire, which does not enter much into the numerator.

So the two things which we want big are $n^2 l^4$ and $n c^2$; wherefore, in case of magnification of circuit for bigger distances, the thickness of the wire should be magnified as well as its length. Of course for really high frequencies it is no use having a thick wire *solid*. It must either be ribbon-shaped, or be stranded, with the strands roughly insulated even if they are not going to be used otherwise than in parallel.

Magnification Ratio.

The amount of magnification of voltage caused by resonance is to be calculated thus:—

The impressed E.M.F., or the E.M.F. of the sending dynamo, being E_0, the effective potential difference between the condenser terminals is such that, when there is syntony and when the damping is small,

$$\frac{V}{p L} = \frac{E_0}{R};$$

in other words, the magnification ratio is

$$\frac{V}{E_0} = \frac{p L}{R} = \tan \alpha,$$

and approaches infinity as the lag of current behind E.M.F. approaches $\frac{1}{2}\pi$.

The primary current without a condenser would be $\frac{E_0}{\sqrt{(R^2 + p^2 L^2)}}$, but with the syntonising condenser it is $\frac{E_0 \tan \alpha}{\sqrt{(R^2 + p^2 L^2)}}$, or, approximately, $\frac{E_0}{R}$.

But it is to be remembered that all hysteresis losses—whether they be due to an iron core in the coil, however sub-divided, or by reason of a stratified or other imperfect dielectric in the condenser—and also all eddy-current losses by reason of induction in neighbouring conductors, whether insufficiently sub-divided iron or earth or sea—all go to increase resistance—*i.e.*, to increase damping—and thereby to diminish the magnification ratio. If the R be measured in the usual way, by steady currents, it is liable to be supposed much smaller than it really is—*i.e.*, smaller than the really effective R for alternating currents—especially for high frequency. Part of the art of magnetic space telegraphy will consist in avoiding or minimising these various sources of loss, all of which show themselves as an increased resistance.

Perhaps the neatest way of proving that the magnification ratio equals $p L/R$ is as follows:—

Since in free oscillations $\frac{1}{2} S V^2 = \frac{1}{2} L C^2$, where V and C are the potential and current-amplitudes respectively, and where $p^2 L S = 1$, we get

$$C = V \sqrt{\frac{S}{L}} = \frac{V}{p L} = \frac{E_0}{\sqrt{(R^2 + p^2 L^2)}};$$

so the magnified or syntonic voltage, when the damping is small, is

$$V = \frac{p L}{R} E_0.$$

To maintain these oscillations is the function of the dynamo, and for this purpose it has only to supply the waste power, viz.,

$$\tfrac{1}{2} R C^2.$$

Hence, in cases where R is large from any cause, considerable power is necessary; but where the R is small, including all the spurious losses which go to make up the effective R or dissipation constant, then violent oscillations can be maintained in a circuit with very little outside power.

The whole matter is analogous to the swinging of a heavy pendulum or bell, whose motion is excited and maintained with little energy if the impulses are properly timed, but which requires more

energy when swung in a viscous fluid. The time of applied impulses should be the same as if it were free, although the actual time of free swing is a little lengthened by the friction.

For circuits oscillating with extreme rapidity one of the principal sources of spurious resistance, and therefore of damping, is radiation of waves, but with these leisurely circuits there is no radiation that need be taken into account in estimating the waste of power. A church bell stiffly hung would become but little easier to swing if its clapper were removed and its wave-emitting property destroyed.

Best Condition for Distant Sending.

Having realised that any distance can be reached if enough copper and enough power are employed, it remains to reckon what is the best way of arranging the copper, and how little will serve to enable a given power to signal a given distance.

When nothing else has to be considered, the condition to be satisfied for signalling to a great distance is to make the magnetic moment of either coil as great as possible; its value is

$$n \pi a^2 \mu C = \frac{\mu \kappa W E}{4 \pi n} \text{ when syntonised;}$$

so all the copper available, w, should be disposed in one large single circuit at each station.

Possibility of Using Iron.

If iron is used as the core of a sending coil, it should be minutely sub-divided, and should, if possible, be hot—as near its critical point as practicable—because then both hysteresis and eddy losses are at their minimum; see a most interesting communication on the behaviour of iron at different temperatures, by Mr. D. K. Morris, in *Proc. Phys. Soc.* for 1896-87.

A transmitter shaped like a chimney or a lighthouse, with a long vertical thin iron strip core surrounded by many turns of wire, would be most efficient if only the damping losses could be got rid of. For the function of the sender is to produce the strongest possible alternating magnetic field at a distance, and this depends simply on magnetic moment, being $\frac{m}{r^3}$ at any distance r in an equatorial plane; and this field, though excessively and imperceptibly weak at any point, is then to be detected by the integrating power of the receiving coil over a large area.

So, in general, if a magnet of moment m oscillates $2 \pi p$ times a second, and the receiving circuit is of area A, the number of lines passing through that circuit is A m/r^3, and p times this is the maximum induced E.M.F. which a telephone or other instrument in the receiving circuit has to detect if it can.

(To be continued.)

APPLICATIONS FOR ELECTRIC LIGHTING PROVISIONAL ORDERS.

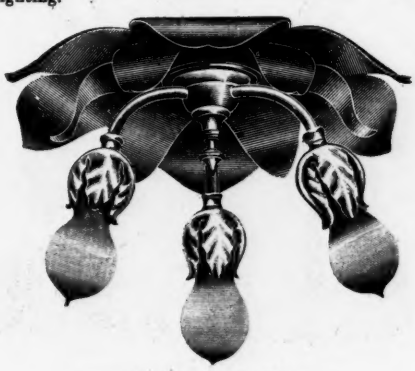
The following is a list of applications for provisional orders which were deposited with the Board of Trade on or before December 21st, 1898, under the provisions of the Electric Lighting Acts, 1882 to 1890:—

Title of Order and Description of Area.	Name of Promoters.
Alloa Electric Lighting Order. The Burgh of Alloa.	The Commissioners of the Burgh.
Arbroath Electric Lighting Order. The Parliamentary Burgh of Arbroath.	The Corporation.
Ashford (Kent) Electric Lighting Order. The Urban District of Ashford.	The Urban District Council.
Audenshaw Electric Lighting Order. The Urban District of Audenshaw.	The Urban District Council.
Aylesbury Electric Lighting Order. The Urban District of Aylesbury.	The Urban District Council.
Barmouth Electric Lighting Order. The Urban District of Barmouth.	David Davies, Esq.
Barnstaple Electric Lighting Order. The Borough of Barnstaple.	The Urban Electric Supply Company, Ltd.
Bexley Electric Lighting Order. The Urban District of Bexley.	The Urban District Council.
Bognor Electric Lighting Order. The Urban District of Bognor.	The Urban District Council.
Bournemouth Corporation Electric Supply Order. The Borough of Bournemouth.	The Corporation.
Brentford Electric Lighting Order. The Urban Sanitary District of Brentford.	The Urban District Council.
Broadstairs, Westgate and Birchington Electric Power Distribution and Lighting Order. The Urban Districts of Broadstairs and St. Peter's, and the Contributory places of Westgate-on-Sea and Birchington-on-Sea.	The Isle of Thanet Light Railways (Electric) Company, Limited.
Burslem Electric Lighting (Extension) Order. The Parish of Wolstanton.	The Corporation.
Camborne Electric Lighting Order. The Urban District of Camborne.	The Camborne Electricity Supply Co., Limited.
Carshalton Electric Lighting Order. The Urban District of Carshalton.	The Electrical Power Distribution Co., Ltd.
Castleford Electric Lighting Order. The Urban District of Castleford.	The Urban District Council.
Cheltenham (Extension) Electric Lighting Order. Borough of Cheltenham.	The Corporation.
Cheriton Urban District Electric Lighting Order. The Urban District of Cheriton.	The Urban District Council.
Christchurch, Pokesdown, and District Electric Lighting Order. The Municipal Borough of Christchurch, the Urban Districts of Pokesdown and Winton, and the Rural District of Christchurch.	The Bournemouth and Poole Electricity Supply Company, Limited.
Clontarf Electric Lighting Order. The Township of Clontarf.	The Township Commissioners.
Cromer Electric Supply Order. The Urban District of Cromer.	The Urban District Council.
Crowborough Electric Lighting Order. The Parishes of Frant, Rotherfield, Buxted, Mayfield, Withyham, and Hartfield.	The Crowborough District Gas Company, Limited.
Darfield Electric Lighting Order. The Urban District of Darfield.	The Urban District Council.
Dukinfield Electric Lighting Order. The Urban District of Dukinfield.	The Urban District Council.
Dumfries Electric Supply Order. The Royal Burgh of Dumfries.	The Corporation.
Durham Corporation Electric Lighting Order. The Municipal City of Durham.	The Corporation.
East Barnet Valley Electric Lighting Order. The Urban District of East Barnet Valley.	The Urban District Council.
Eastbourne Electric Supply Order. The Borough of Eastbourne.	The Corporation.
East Retford Electric Supply Order. The Borough of East Retford.	The Corporation.
Electrical and General Engineering Company Order (*see* Hendon).	
Erith Electric Lighting Order. The Urban District of Erith.	The Urban District Council.
Failsworth Electric Supply Order. The Urban District of Failsworth.	The Urban District Council.
Farnborough Electric Lighting Order. The Urban District of Farnborough.	The Urban District Council.
Fenton Electric Lighting Order. The Urban District of Fenton.	The Urban District Council.
Finchley Electric Lighting Order. The Local Government District of Finchley.	The Urban District Council.
Gateshead Electric Lighting Order. The Municipal Borough of Gateshead.	The Electrical Power Distribution Co., Limited.
Glossop Corporation Electric Lighting Order. The Borough of Glossop.	The Corporation.
Gorton Electric Supply Order. The Urban District of Gorton.	The Urban District Council.
Grays Thurrock Electric Lighting Order. The Urban District of Grays Thurrock.	The Urban District Council.
Guildford (Extension) Electric Lighting Order. The Rural Districts of Guildford and Hambledon.	The Guildford Electricity Supply Co., Limited.
Halesowen Electric Lighting Order. The Rural District of Halesowen.	The Rural District Council.
Handsworth Electric Supply Order. The Urban District of Handsworth.	The Urban District Council.
Hartlepool Corporation Electric Lighting Order. The Municipal Borough of Hartlepool.	The Corporation.
Haslemere and District Electric Lighting Order. The Parishes of Haslemere and Shottermill and portions of the Parishes of Frensham and Thursley.	E. O. Preston, Esq.
Haslingden Electric Lighting Order. The Municipal Borough of Haslingden.	The Corporation.
Hawick Electric Lighting Order. The Burgh of Hawick.	The Urban Electric Supply Company, Limited.
Heaton Norris Electric Lighting Order. The Urban District of Heaton Norris.	The Urban District Council.
Hendon Electric Lighting Order. The Parish and Place of Hendon.	The Electrical and General Engineering Company.
Heywood Electric Supply Order. The Borough of Heywood.	The Corporation.
Horsham Electric Lighting Order. The Urban District of Horsham.	The Urban District Council.
Ilkeston Electric Supply Order. The Borough of Ilkeston.	The Corporation.
Inverness Electric Lighting Order. The Royal Burgh of Inverness.	The Corporation.
Keighley Electric Supply Order. The Borough of Keighley.	The Corporation.
Kilmarnock Electric Lighting Order. The Burgh of Kilmarnock.	The Corporation.
Kirkcaldy Electric Lighting Order. The Municipal Burgh of Kirkcaldy.	The Corporation.
Knutsford Electric Supply Order. The Urban District of Knutsford.	The Urban District Council.

Title of Order and Description of Area.	Name of Promoters.
THE COUNTY OF LONDON:—	
Battersea and Fulham Electric Lighting Order. The Parish of St. Mary, Battersea, and the Parish of Fulham.	The County of London, and Brush Provincial Electric Lighting Company, Limited.
Bermondsey Electric Lighting Order. The Parish of Bermondsey.	The Vestry.
Bethnal Green Electric Lighting Order. The Parish of Bethnal Green.	The Vestry.
Blackheath and Greenwich District (Extension) Electric Lighting Order. Portion of the Lee District.	The Blackheath and Greenwich District Electric Lighting Company, Limited.
City of London Electric Lighting Order. The City of London and the Liberties thereof.	The Charing Cross and Strand Electricity Supply Corporation, Ltd.
City of London, St. Luke, Middlesex, and Holborn Electric Lighting Order. The City of London, the Parish of St. Luke, Middlesex, and the Holborn District.	The Smithfield Markets Electric Supply Company, Limited.
County of London (East) Electric Lighting Order. The Parishes of St. Mary, Stoke Newington, Hackney, and St. Matthew, Bethnal Green, and Districts of Poplar and Whitechapel.	The County of London and Brush Provincial Electric Lighting Company, Limited.
County of London (South-East) Electric Lighting Order. The Parishes of Bermondsey, Rotherhithe, St. Paul, Deptford, and St. Nicholas, Deptford, portion of the Parish of Lambeth, and the Districts of Lewisham and Lee.	The County of London and Brush Provincial Electric Lighting Company, Limited.
Kensington Vestry Electric Supply Order. The Parish of St. Mary Abbotts, Kensington.	The Vestry.
Lewisham District Electric Lighting Order. The Lewisham District.	The Board of Works.
Metropolitan Electric Supply (City) Lighting Order. The City of London.	The Metropolitan Electric Supply Co., Ltd.
Plumstead Vestry Electric Lighting Order. The Parish of Plumstead.	The Vestry.
Longton Electric Supply Order. The Borough of Longton.	The Corporation.
Ludlow Electric Supply Order. The Borough of Ludlow.	The Corporation.
Lye and Wollescote Electric Lighting Order. The Urban District of Lye and Wollescote.	The Urban District Council.
Lymington Electric Lighting Order. The Borough of Lymington.	The Lymington Electric Light and Power Company, Limited.
Maerdy Electric Lighting Order. Portion of the Parish of Ystradyfodwg.	The Mardy Electric Light Company, Limited.
Mansfield Corporation Electric Lighting Order. The Borough of Mansfield.	The Corporation.
Merthyr Tydfil Electric Lighting Order. The Urban District of Merthyr Tydfil.	The Merthyr Electric Traction and Lighting Company, Limited.
Mexborough Electric Lighting Order. The Urban District of Mexborough.	The Urban District Council.
Midland Electric Power Distribution and Lighting (Extension) Order. The Borough of West Bromwich, the Urban Districts of Amblecote, Brierley Hill, Handsworth, Perry Barr, Quarry Bank, and Smethwick, the Rural District of Kingswinford, and a portion of the Rural District of Walsall, in the County of Stafford; and the Borough of Dudley, the Urban Districts of Lye and Wollescote, Oldbury, and Stourbridge, and the Rural District of Halesowen, in the County of Worcester.	The Midland Electric Corporation for Power Distribution, Limited.
Mirfield Electric Lighting Order. The Urban District of Mirfield.	The Urban District Council.
Musselburgh Electric Lighting Order. The Burgh of Musselburgh.	The Drake & Gorham Electric Power and Traction (Pioneer) Syndicate, Limited.
Newcastle-under-Lyme Electric Supply Order. The Municipal Borough of Newcastle-under-Lyme.	The Corporation.
Newport (Isle of Wight) Electric Lighting Order. The Borough of Newport (Isle of Wight).	The Ventnor Electric Light and Power Company, Limited.
Newton Abbot Electric Lighting Order. The Urban District of Newton Abbot.	The Urban Electric Supply Co., Ltd.
Partick Electric Lighting Order. The Burgh of Partick.	The Kelvinside Electricity Company, Limited.
Pemberton Electric Supply Order. The Urban District of Pemberton.	The Urban District Council.
Penzance Electric Lighting Order. The Borough of Penzance.	The Urban Electric Supply Company, Ltd.
Rawtenstall Electric Lighting Order. The Borough of Rawtenstall.	The Corporation.
Rhyl Electric Lighting Order. The Urban District of Rhyl.	The Urban District Council.
Royal Leamington Spa Electric Lighting Order. The Borough of Royal Leamington Spa.	The Corporation.
Royal Leamington Spa Electric Light and Power Order. The Borough of Royal Leamington Spa.	The Midland Electric Light and Power Company, Limited.
Rugby Electric Lighting Order. The Urban District of Rugby.	The Urban District Council.
Runcorn Electric Lighting Order. The Urban District of Runcorn.	The Urban District Council.
Ryde Electric Lighting Order. The Borough of Ryde.	The Corporation.
Ryde Electric Lighting Order. The Borough of Ryde.	The Ryde Electric Light and Power Co., Ltd.
Sandown and Shanklin Electric Lighting Order. The Urban Districts of Sandown and Shanklin.	The Ventnor Electric Light and Power Company, Limited.
Shipley Electric Lighting Order. The Urban District of Shipley.	The Urban District Council.
Slough and Datchet Electric Lighting Order. The Parishes and Places of Farnham Royal, Stoke Poges, Datchet, Slough, and Upton-cum-Chalvey.	Messrs. Laing, Wharton, and Down, Limited.
Stourbridge Electric Lighting Order. The Urban District of Stourbridge.	The Urban District Council.
Sutton Coldfield Electric Lighting Order. The Borough of Sutton Coldfield.	The Corporation.
Swinton Electric Lighting Order. The Urban District of Swinton.	The Urban District Council.
Swinton and Pendlebury Electric Lighting Order. The Urban District of Swinton and Pendlebury.	The Urban District Council.
Teignmouth Electric Lighting Order. The Urban District of Teignmouth.	The Urban District Council.
Twickenham and Teddington Electric Lighting Order. The Urban Districts of Twickenham and Teddington.	The Twickenham and Teddington Electric Supply Company, Ltd.
Walker Electric Lighting Order. The Urban District of Walker.	The Urban District Council.
Walton-on-Thames and Weybridge Electric Supply Order. The Urban Districts of Walton-on-Thames and Weybridge.	The Electric Works Company, Limited.
Wath-upon-Dearne Electric Lighting Order. The Urban District of Wath-upon-Dearne.	The Urban District Council.
Wednesbury Electric Supply Order. The Borough of Wednesbury.	The Corporation.
West Kent Electricity Supply Order. The Parishes and Places of Bexley, Crayford, and Erith.	The West Kent Electricity Supply Company, Limited.
Weston-super-Mare Electric Lighting Order. The Urban District of Weston-super-Mare.	The Weston-super-Mare Electric Light and Power Syndicate.
Winsford Electric Lighting Order. The Urban District of Winsford.	The Urban District Council.
Worksop Electric Lighting Order. The Urban District of Worksop.	The Urban District Council.

EDISWAN FITTINGS.

THE new fittings catalogue of the Edison & Swan United Electric Light Company contains a very large variety of fancy fittings for electric lighting.



THREE-LIGHT CEILING FITTING.

The fittings branch of the electric lighting industry is a great debtor to the inventive ingenuity and artistic skill of their designers,

the quality of whose taste seems to show no falling off, if we may judge from several recently published lists. On the contrary, there is every evidence that the artistic side of electric lighting work is

One-Light Fancy Bracket.

Fancy Pendant.

receiving more and more attention every year. There are many very pleasing designs of electroliers, pendants, and brackets in the Ediswan catalogue, and we take the opportunity of illustrating some of the best specimens. There is little to be said in the way of description of any one fitting; they must speak for themselves. There is something noble looking about the one-light fancy cast polished brass bracket shown in one of our illustrations, and a two-light bracket of the same design would be certainly no less imposing.

The three-light ceiling fitting shown is supplied in either gilt, brass, or gilt and copper.

We also illustrate a choice fancy rise and fall pendant with lined silk shade and gold beaded fringes. This is supplied complete wired with flexible cord.

There is so excellent a variety of electroliers that it is difficult to make a selection. The eight-light polished brass electrolier with silk tassels and cord makes a handsome centre-fitting. As an instance of the cheaper specimens, the three-light electrolier supplied in polished brass, or black bronze, is very ornamental.

Eight-Light Electrolier.

In addition to the above, the catalogue is studded with a large number of bronze figures and other fittings, special attention being drawn to the pages devoted to descriptions of outside shop fittings for high C.P. lamps.

AMERICAN MACHINE TOOLS.

We have already drawn attention to the discussion in the *Engineer* upon the merits of American tools. As usual in such discussions, correspondents express their views in exaggerated language. One Mr. Campbell is very strenuous in his advocacy of American tools,

and more particularly on the feed speed and cutting speeds, and return speeds of planers.

It is perhaps good that he should write strongly, though he is apparently smarting under some special instance of English delay, and he exaggerates both American virtues and English vices. We

Ediswan Fittings.—Three-Light Electrolier.

know ourselves that there is a considerable basis of truth in much which he says, and there is equally as much truth in his opponents. Both sides write with bias. In these columns we have not failed to point out that much lethargy has come upon English machine tool makers, by reason of the clogging action of the Amalgamated Society of Engineers. We have been accused of speaking too strongly of Mr. Barnes, of the Amalgamated Society of Engineers, but all we have said melts into insignificance beside a letter in *Engineering*, wherein his doings are pilloried in a most unmerciful manner. But to resume. Mr. Barnes has much to answer for in respect of the backward state of machine tool making. It has not paid to throw out strong tools still in good order, and capable of doing excellent work at twice the trade union speed, simply to put in new tools capable of working still quicker. All incentive to rapid working has been destroyed, but with the destruction of the Barnes influence, there has sprung up a demand for better tools, and while Americans will be the first to profit by it, the demand will in due time be met at home.

In the meantime Mr. Barnes's boast that he has been the means of causing a loss of £25,000,000 to the employers, bids fair to be warranted over and over again. Would that he had been as moderate in other ways. With a more hopeful future the specialisation of machine tools and the makers of them will be brought about. In America one finds a firm devoted wholly to the making of a few sizes of one machine. Across the street another firm is doing the same by another machine. Here we find one firm making planers, lathes, drills, and other tools. As a rule they make one tool better than they make the others, and they acquire a character for certain lines, but they do not stick to that particular line as they should do, and leave the others to other firms better equipped.

American tools are not perfect. They often fail in alignment. Their lathes are poor concerns, and to the English mind they don't seem to be capable of learning their weak points any better than if they were veritable John Bulls. Both sides might learn from the other, and we suppose that many of the differences in cutting speeds are due to differences of material, especially in respect of the hardness or otherwise of cast-iron. One of the correspondents of the *Engineer* seems to throw a doubt upon the quality of Mr. Campbell's gas engine cylinders if they can be bored out at the speeds claimed. Given the possibility of so high a speed, is it possible that Mr. Campbell's engines are too soft in the cylinder? Let us hope not; but this is the thought which has evidently occurred, to one who doubts the standing up of the boring tool at such a speed, on properly hard metal. The discussion is illustrative of the freedom with which Englishmen criticise themselves. While this freedom exists, it is not very likely we shall drop very far back in the race, if we can only be equally free of the mischievous efforts of men who see credit in causing a loss of millions. Let us hope Mr. Barnes will find different and more honourable means of distinction than those which, in the past, have appealed to his intelligence.

WATER-TUBE BOILERS.

In the annual summary of progress, the *Engineer* refers to the steady improvement of the Belleville boiler in respect of the troubles being gradually overcome, which have been so pronounced a feature of its working, and were well commented upon by Mr. Gretchin, of the ss. *Kherson*, which consumed nearly 2¼ lbs. of coal per I.H.P. It is questioned if the enormous sums of money spent in developing the water-tube boiler would not have been better spent upon other types. So much as yet appears uncertain in the water-tube marine boiler, and its economy is exceedingly doubtful, even with every allowance for reduced weight, a matter of very much less importance in long voyages than short. The new White Star vessel, *Oceanic*, will, it is said, make the round voyage of the world at about 12 knots. Would she be able to do this with Belleville boilers? Probably not, for the extra coal carried would not, on so long a voyage, compensate for the greater hourly consumption of fuel. As we have before pointed out, the relative importance of a light weight boiler in the British navy is less than the same quality in the French navy. The English navy exists to protect an empire scattered over the whole world.

The French navy exists as a means of being unpleasant to near neighbours, and has for its first object the impoverishment of France's best customer and the assistance of one of her worst customers and most persistent borrowers. The *Engineer* speaks favourably of the Mumford boilers fitted in the *Salamander*, and implies that it is superior to every other type of navy boiler, including even the Niclausse to which the palm is awarded by M. Bertin. The water-tube boiler is still quite on trial, and should be adopted in a tentative manner only until such time as its merits and demerits are more thoroughly understood and equated. In the case of the ss. *Kherson*, Mr. Gretchin reports trouble from leakage between the bottom boxes and the feed water collectors, especially when the vessel listed in either direction. Four tubes burst in the round voyage between Odessa and Vladivostock, and each required 10 hours' work in port to replace. In one case the water ran out of the boiler so rapidly that the tubes all became red hot from top to bottom of all eight elements before the fires could be fully drawn. The opening proved to be 5 inches long by ½ inch maximum width. Three out of four tubes were bent on arrival home.

There were continually employed throughout the voyage, during two-thirds of the steaming days, one artificer and one fireman to keep the boilers in condition to work, while at ports of call three artificers and 10 firemen had their hands full of repair work. The record is not such as to lead any engineer to repose much confidence in the Belleville type without, to say the least, considerable modification. Shall we be afforded equally full information upon the boilers of our own two large cruisers, *Powerful* and *Terrible*, or will any defects be hidden in a veil of official secrecy? Their defects, if they do exist, should preferably be made public before the hour of action, which will be an awkward hour for naval constructors at its best.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

27,276. "Improvements in supporting and take-up devices for cable-suspended electric lamps." J. H. Dorion. Dated December 27th.

27,320. "Improvements in and relating to electric motors and method of controlling same." S. Y. HEBBNER. Dated December 27th. (*Complete*)

27,334. "Improvements in telephone receivers." P. M. JUSTICE. (A. T. Nye, United States.) Dated December 27th.

27,335. "Improvements in telephone transmitters." P. M. JUSTICE. (A. T. Nye, United States.) Dated December 27th.

27,336. "Improvements in apparatus for use in telephone exchanges." P. M. JUSTICE. (A. T. Nye, United States.) Dated December 27th.

27,360. "An apparatus or improved manner of means for determining or ascertaining the velocity of air currents in coal mines and other situations, and for other purposes by novel electrical and other means." J. THOMPSON. Dated December 28th.

27,370. "Improvements in the automatic compounding of monophase or polyphase alternators." R. B. RANSFORD. (The Societe Sautter, Harle & Cie, France.) Dated December 28th. (*Complete.*)

27,390. "Improvements in coin-freed apparatus for electric and fluid meters." C. D. ABEL. (Societe Anonyme Continentale Pour la Fabrication des Compteurs a Gas et Autres Appareils, France.) Dated December 28th.

27,414. "Improvements in or relating to electric lamp bracket joints." J. CLARKE. Dated December 29th.

27,453. "Improvements in electric motors." H. LEITNER Dated December 29th.

27,469. "A process for the electro-deposition of vanadium." S. O. COWPER-COLES. Dated December 30th.

27,473. "Improvements in graduated resistance apparatus for starting on reversing electro-motors." D. STEWART & Co., LTD. Dated December 30th.

27,498. "Improvements in electric incandescent lamps." G. ZAHIKJANZ Dated December 30th.

27,526. "Improvements in thermo-electrical building bricks or blocks." J. MATTHIAS. Dated December 30th. (*Complete.*)

27,531. "Improvements in and connected with graphophones." A. G. BROOKES. (The Joint Stock Company, styled "Berliner electro-mechanische Werkststten Gesellschaft mit beschrankter Haftung," Germany.) Dated December 30th. (*Complete.*)

27,541. "Improvements in detachable and swivelling electric light fittings." J. F. WAKELIN and C. J. WESTON. Dated December 31st.

27,556. "Improvements in incandescent electric lamps." R. BOTTELLI. Dated December 31st.

27,564. "Improvements of controlling apparatus for electric lifts and other machines." J. S. STEVENS, C. G. MAJOR, and E. C. STEVENS. Dated December 31st.

27,577. "Improvements in motor-driven vehicles and in electric motors therefor." W. A. CROWDUS. Dated December 31st.

27,583. "Improvements in electric arc lamps." F. S. WOBSLEY. Dated December 31st.

27,586. "Improved direct coupled driving arrangement for electric automotors." E. EGGER. Dated December 31st.

27,592. "Improvements in controllers for electric motors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. B. Potter, United States.) Dated December 31st. (*Complete*)

27,593. "Improvements in systems of train control for electrically propelled vehicles." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (F. E. Case, United States.) Dated December 31st. (*Complete.*)

27,599. "Improvements in electro-hydraulic brakes for railway vehicles and other purposes." C. DUREY. Dated December 31st. (*Complete.*)

27,613. "Improvements in electric fuse-holders." C. HOWARD. Dated December 31st. (*Complete.*)

27,614. "Electrolytic or battery liquid." J. R. HATMAKER. Dated December 31st.

27,636. "Improvements in electric arc lamps." A. M. ALTER. Dated December 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of MESSRS. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free*, 9d. (*in stamps*).

1897.

15,495. "Improvements in contact boxes for electric railways." W. M. BROWN. Dated June 29th, 1897. Relates to improvements in contact boxes for electric railways, and consists of a base portion having a cavity covered by a lid, the centre being of non-magnetic material and sides of cast-iron, the cover has also a cavity forming an addition to the cavity in the base. The switch member consists of a ball floating in mercury. The ball and mercury are contained in a cup formed of two parts so that when the mercury and ball are in it may be sealed up. The bottom of the cup has a contact piece one end in contact with the mercury and the other end connected to the feeder circuit. The top cup has also a contact piece. 5 claims.

19,846. "Improvements relating to the manufacture of plates for electric accumulators." L. GUELKOW. Dated August 28th, 1897. A lead plate of rectangular shape with a number of horizontal slots, edges of which are turned to opposite sides to hold the active material in place. The plate is placed in an asbestos frame which serves as a separator; the frame is composed in two parts formed with projections to bear against adjacent frames and with holes for access of the electrolyte. The active material consists of a mixture of minium, litharge, potassium acetate, and dilute sulphuric acid. The plate is made by stamping, and the active material is applied by pressure. 2 claims.

19,955. "Improvements in and relating to sleeves or sockets chiefly designed for simultaneously connecting globes, reflectors, and the like to electrical incandescent lamps." C. BARTENSTEIN. Dated August 30th, 1897. *Incandescent lamps.*—Relates to an adapter for holding a screw-capped lamp and a reflector, shade, or globe in a plain holder. The cap of the lamp is screwed into a tube attached to an adapter which fits the ordinary holder. An insulated bolt makes the central connection. The reflector is clamped on the adapter by a flanged ring screwed on a tube. The adapter may be of the same size as the lamp cap; or the tube may be of a size to receive a small capped lamp. The adapter may be modified for bayonet-joint lamps and holders, and the ring may be secured by a bayonet-joint instead of a screw. 5 claims.

19,995. "Improvements in means for effecting magnetic transmissions." G. ENGISCH and T. KÖNIG. Dated August 31st, 1897. A rod of loadstone is divided transversely into two equal parts, which are then placed together end to end and magnetised. The parts are then separated and used to form two corresponding sympathetic magnetic needles. Each needle consists of a magnetised part and a pointer of brass, and is mounted in a casing above an aluminium disc and dial. The dial is supported by an ebonite cylinder on one or two zinc plates. The apparatus may be employed, with or without a call bell, for transmitting signals, either needle serving as a transmitter and the other as a receiver. The transmitting needle is moved over its dial to the desired letter or sign, and produces a corresponding movement in the receiver. The apparatus may also be employed for making and breaking an electric circuit for firing shots in mines, or for starting and stopping machinery at a distance, &c. 2 claims.

20,043. "Improvements in or connected with railway signals." J. G. LORRAIN. (C. W. Grant.) Dated August 31st, 1897. The rails, A, B, are divided into insulated sections, and between the rails of each section is arranged a set of coils, C, which are joined in series and are connected up to the rails of, say, the second section, A^2, B^2, in advance. On an engine mounted a coil E through which a current is always passing from the alternating current generator, F, and a coil, E^1, the circuit of which includes an alarm bell. When a train is in one section, B^2, the circuit of the coils are completed, and should a train then enter the section, A, B, the current in the coil E induces a secondary current in the coils C, and this latter current induces a tertiary current in the coil E^1, which sounds the bell. The coil E also induces a current in the testing coil, which energises the electro-magnet, the armature of this magnet being normally attracted and preventing the mechanical bell from ringing. In case of failure of the circuit of the coil E, the armature is released and allows the mechanical bell to ring. By means of a switch, the circuit of the coil E^1 can also be included in the testing circuit. For single lines, two sets of coils, C, are employed, one set being connected to the second section on advance, and the other to the second section in the rear. The circuit of the coils C may also be closed by an electric switch operated by the adverse movement of a drawbridge, turntable, or points, &c. One or more track coils, C^1, connected to a bell, may be placed at level crossings, &c. One or more track coils, C^1, connected to a bell, may be placed at level crossings, &c., to give warning of an approaching train. 13 claims.

20,317. "Improvements in, or relating to, dynamo-electric machinery." C. L. ROSENQUIST. Dated September 3rd, 1897. *Dynamos and Motors.*—Relates more particularly to machines capable of being operated either as single-phase alternating current motors or as direct current motors. Some of the improvements are applicable to motors and generators of the ordinary type. These machines may also be used for converting alternating currents into direct currents, and *vice versâ*. *Armatures.*—The armature is constructed with two or more separate cores, mounted side by side on the same spindle. In the figure they are, for clearness, shown as arranged concentrically. Each core is wound with coils, and the coils on the several cores are staggered and connected in succession to a single commutator in the manner shown. To obviate cross-connecting the commutator bars in a multipolar machine, the armature winding may be passed through two diametrically opposite slots in one core, then through two similar slots in the next, and so on. In a drum armature each slot accommodates three wires, which pass in zig-zag fashion through the slots on adjacent cores, each core embracing three poles. *Commutators; Collecting Rings.*—Two collecting rings are connected with two segments of the commutator, which, in a four-pole machine, are separated by 90°. At starting, an alternating current is supplied to the commutator brushes, but when the motor reaches synchronism, the mains are connected with the brushes bearing on the collecting rings. *Field Magnets.*—The field magnet is provided with two windings, one of which consists of a few turns for conveying the alternating current at starting, and the other of many turns for conveying the rectified current after synchronism. These windings are displaced relatively to each other, so that the induced currents produced in the coils, 19, at starting neutralise one another. According to another arrangement, the poles are divided into sections, and the series coils are wound on separate sections, while the shunt coils are wound so as to embrace the whole pole. *Motors controlling; dynamos regulating.*—In order to vary the field magnetism as the strain on the pulley varies, a movable sleeve, having an inclined surface bearing against a similar surface on the pulley, operates a lever controlling the resistance in the circuit. *Alarms and Signals.*—When the shaft attains a certain speed a centrifugal contact closes the electric circuit and throws in a lamp or alarm. 5 claims.